



**US Army Corps
of Engineers**
Pittsburgh District

April 2010

**East Branch Dam
East Branch Clarion River
Elk County, Pennsylvania**



Dam Safety Modification
ENVIRONMENTAL ASSESSMENT

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ENVIRONMENTAL ASSESSMENT

East Branch Dam East Branch Clarion River Elk County, Pennsylvania

East Branch Dam Safety Modification

Summary

1. Preliminary dam safety studies completed during January 2008 revealed that East Branch Dam may have structural deficiencies that could cause it to fail unexpectedly.
2. Because of confirmed and unconfirmed risk, the District—whose mission priority is public safety—decided in February 2008 to lower operating pool levels to make the dam safer, until further studies could be completed.
3. The new maximum summer pool was lowered 20 feet (from elevation 1670 to 1650) to reduce the hydraulic head and seepage within the dam. The maximum winter pool was lowered 28 feet (from elevation 1651 to 1623).
4. East Branch Dam is currently operating with reduced risk under this new operating schedule and will continue to provide flood risk reduction downstream. Periodic storage of floodwaters will not reduce dam safety.
5. The impacts of the lowered pool were addressed in an environmental assessment (EA) prepared and circulated for agency and public review in the spring of 2009.
6. This EA analyzes the impacts of the following five dam repair plan alternatives:
 - *NS1*: Non-Structural, the “No Action” alternative; operate at reduced maximum summer pool (El. 1650) and continue interim risk reduction measures,
 - *S3*: Structural; full-depth cut-off wall, full length of embankment with grouting,
 - *S4*: Structural; dam extension immediately downstream and fortification,
 - *S5*: Structural; downstream concrete gravity structure positioned downstream,
 - *S6*: Structural; removal of dam.
7. Based upon engineering and cost analysis, Plan S3 best achieves the desired level of safety for the least cost. Additionally, this plan will not cause any long-term significant adverse environmental or socio-economic impacts, either within the lake or downstream. The current interim operating pool and low-flow augmentation schedule will be maintained during construction. Thus, Plan S3 is the preferred plan.

ENVIRONMENTAL ASSESSMENT

East Branch Dam Safety Modification

1.0 Purpose of and Need for Action

In January 2008, East Branch Dam was determined by the U.S. Army Corps of Engineers (the Corps) to be potentially unsafe. To ensure public safety, the Corps' Pittsburgh District temporarily changed the operation of the dam in February 2008 by lowering summer and winter pools to reduce hydraulic loads on and within the dam to acceptable levels. Since then, the District has formulated and evaluated repair alternatives, with the purpose of implementing an alternative that permanently reduces the risk of dam failure to meet the Corps' tolerable risk guidelines. The need for this action is to reduce the probability of failure of the dam and, in turn, to reduce the potential risk of life loss, and economic and environmental impacts downstream. Measures have been developed by the District to assess the ability of each repair alternative to meet project needs, and criteria established that define the level of acceptable risk (these criteria are discussed in Sec. 3.11).

2.0 General Background Information

2.1 Project Authorization and Construction History

East Branch Dam was authorized for construction by the Flood Control Act of December 22, 1944 (Public Law 534 of the 78th Congress, second session, H.R. 4485), which provides in Section 10, as follows:

“...that the general comprehensive plan for flood control and other purposes, approved in the Flood Control Act of June 28, 1938, for the Ohio River Basin, is hereby modified to include the construction of flood-control works for the protection of Ridgway, Johnsonburg,... in the state of Pennsylvania...”

The authorized purposes of East Branch Dam include flood control on the Clarion River, water quality, low-flow augmentation, recreation, and conservation of fish and wildlife.

Construction of the dam began in June 1947 when the initial construction contract was awarded. The dam was completed and put into full operation by June 1952.

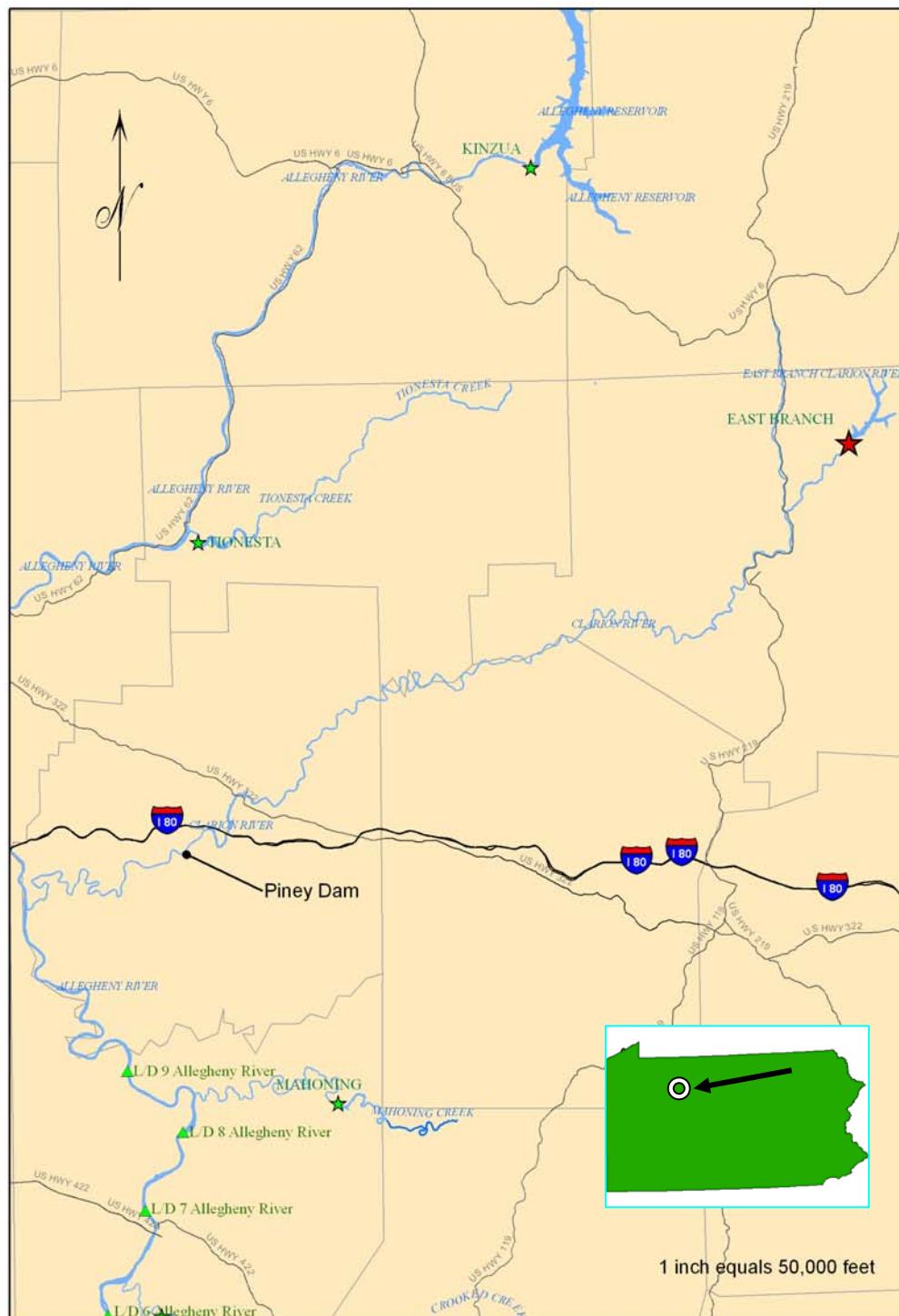
The Flood Control Act of 28 June 1938 provides the authority to pursue the seepage corrections at East Branch Dam. Under current policy, “Seepage Control and Static Instability Correction” projects are types of rehabilitation projects and will be pursued under the Construction General program in accordance with Engineer Circular 11-2-194.

2.2 Location

East Branch Dam, which forms East Branch Clarion River Lake (hereafter referred to as “East Branch Lake”), is located in a remote rural area of northwestern Pennsylvania, in Elk County, on the East Branch Clarion River (**Fig. 1**). The community nearest the dam is the small village of Glen Hazel, which lies less than two miles downstream. The next community, Johnsonburg, is located about seven miles downstream of the dam, at the confluence of the East Branch and West Branch Clarion Rivers, where they combine to form the Clarion River main stem. From Johnsonburg, the Clarion River flows west-southwest on a sinuous course for about 102 miles to its confluence with the Allegheny River, about two miles south of the community of Foxburg. For additional information on the area, see:

<http://www.paconserve.org/rc/pdfs/crwtm.pdf>

Figure 1 – General Location, East Branch Dam



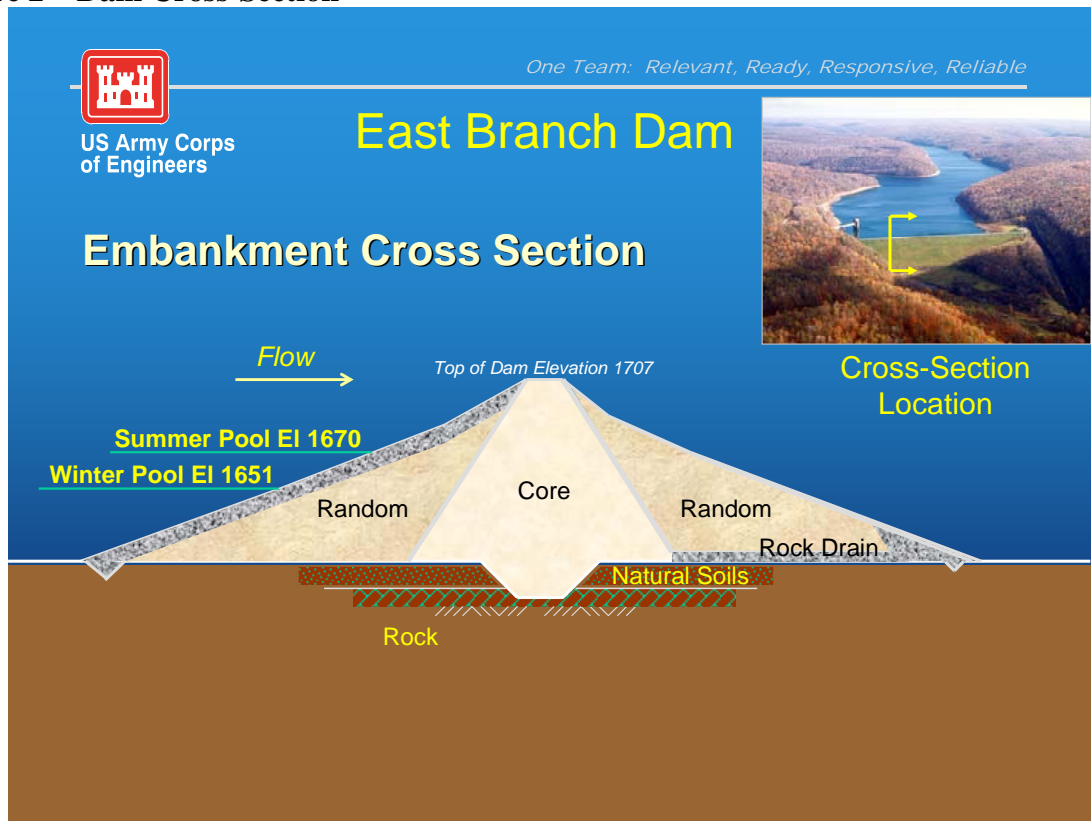
2.3 Structural Data

2.3.1 Dam

The dam is a rolled earth fill embankment with outlet works located at the right descending abutment and an emergency spillway located in the left abutment. (**Note:** *right bank* and *left bank* are always from the perspective of looking downstream.) The embankment is 1,725 feet in length, with a height of 184 feet, with top-of-dam elevation 1707 feet above the National Geodetic Vertical Datum (NGVD). (**Note:** all future references to elevation are in feet above NGVD; e.g., El.1707, or elevation of 1707). The dam's width at its top is 20 feet, with a maximum width of 1,115 feet at its base. A layer of rock protects the upstream slope from wave erosion, and the downstream slope has a grass cover.

The dam nominally consists of a central core of select impervious material with random fill zones on the upstream and downstream sides. See a cross-section of the dam below (**Fig. 2**).

Figure 2 – Dam Cross-Section



To provide some perspective on the height of the dam embankment, see **Photo 1** below.



Photo 1 - A portion of the downstream face looking at the dam's right abutment. The picture was taken from near the base of the dam. From its base to the top, the dam is 184 feet high.

2.3.2 Spillway

A concrete-lined spillway is located at the left end of the embankment in left abutment rock, aligned roughly perpendicular to the dam axis. The spillway prevents overtopping of the dam during extreme rainfall events. The project has only experienced spillway flow once, in 1972 during Hurricane Agnes. The spillway entrance is an uncontrolled weir, 250 feet wide at crest El.1685. The inlet weir is straight and parallels the right side of the channel (see **Photos 2 and 3**). During high water events, flood water goes over the spillway weir and enters the spillway chute which is a 2,105 foot-long concrete channel that ends in a stilling weir with a dispersal bucket for energy dissipation. (**Photo 4** shows the inside of the concrete-lined spillway).

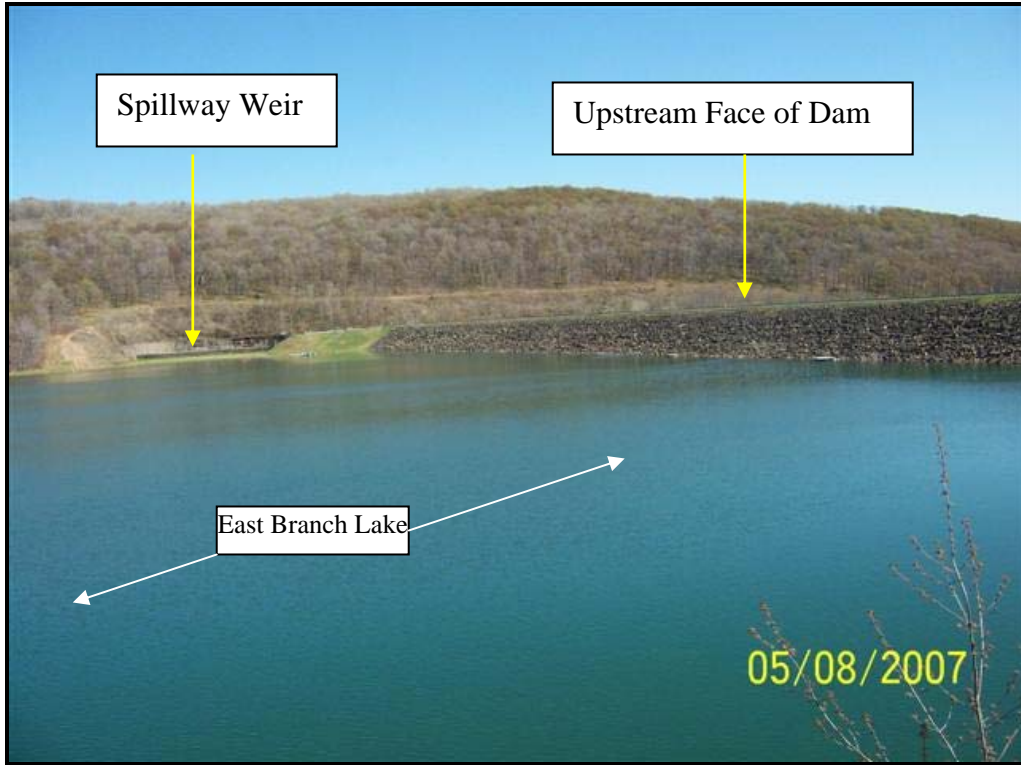


Photo 2 – Looking from the right descending bank across the lake to the spillway weir at the left descending bank.



Photo 3 – Closer view of spillway weir at the left descending bank.



Photo 4 – A view from inside the concrete-lined spillway. When examined closely, three inspectors are in view further down the spillway, which helps give perspective to the photo.

2.3.3 Intake Tower and Outlet Works

The outlet works are located at the right abutment and consist of a control tower



(partially submerged; **Photo 5**, left), a single-barrel concrete-lined tunnel through the bedrock of the right abutment, and a stilling basin. The barrel tunnel is 10 feet in diameter and approximately 1,250 feet in length. **Photo 6** shows the control tower with intakes exposed, and **Photo 7** shows the downstream discharge exit of tunnel outlet. East Branch Dam discharges water from the reservoir through several gates and intakes located at various elevations within the tower. Two large 3'-4"x 12' sluice gates are located at the base of the tower at El.1531,

which is the elevation of the original East Branch Clarion River channel bottom.

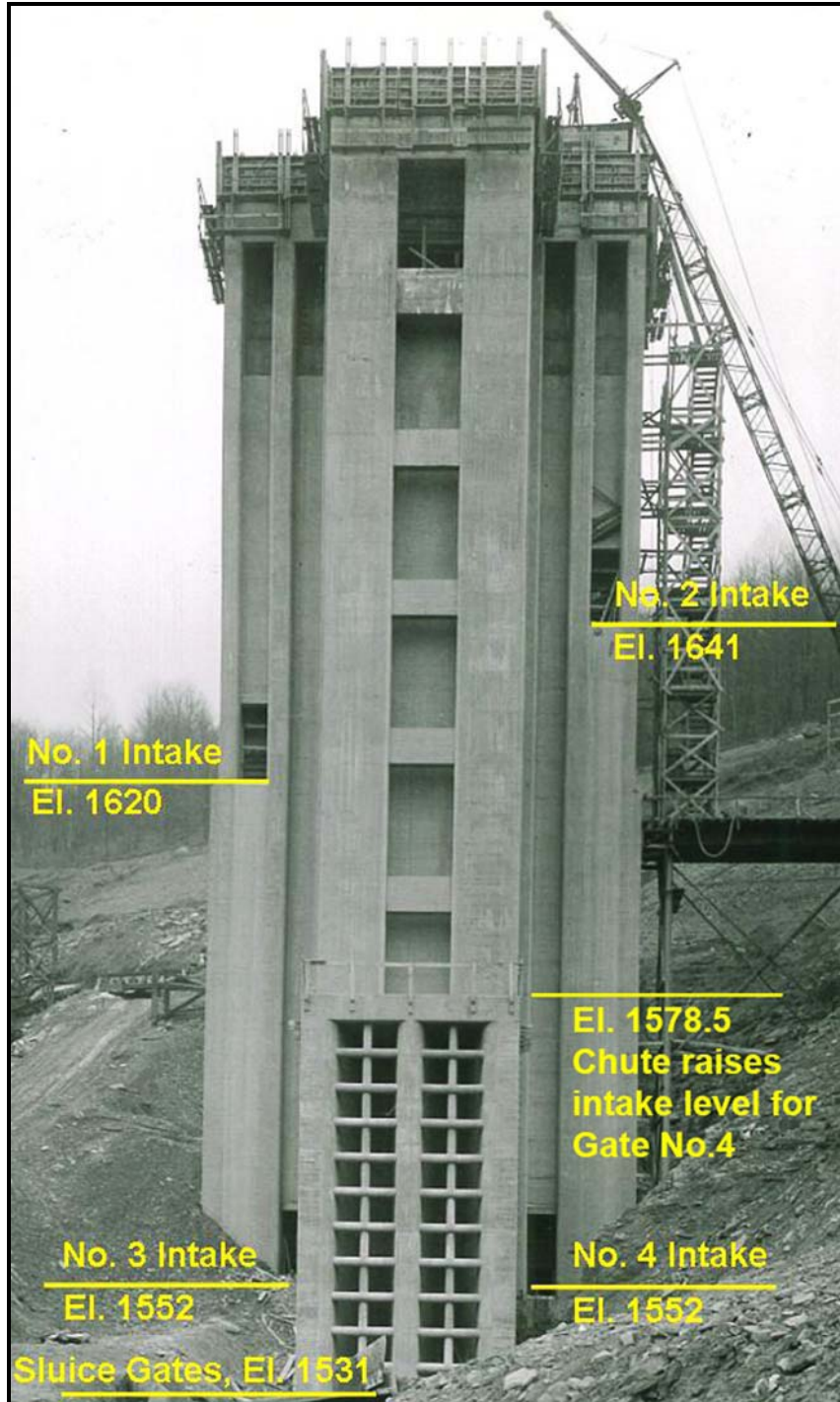


Photo 6 - The control tower and its water intakes under construction during the late 1940's. The water quality intakes are at elevations 1641, 1620, and 1552. An external water intake extension or "chute" was installed on the face of the control tower in October 2008, that effectively raised the elevation of the No.4 intake from El.1552 to 1578.5 (an increase of 26.5 feet). This provided more flexibility in controlling the temperature of water discharges when the pool surface drops below El.1620 at intake No.1 (see Sec. 2.3.5 for more information about the "chute" and the reasons for its construction).

If needed, the large sluice gates could drain the reservoir completely, allowing “run-of-river” channel flow to safely pass through the dam's right abutment outlet works. Four water quality control intakes are located in the control tower and are used for downstream water quality flows. One intake is located at El.1641, one at El.1620, and two are located at El.1552. (One of the El. 1552 intakes was modified by the installation of an external "chute" which effectively raised its elevation 26.5 feet, from El.1552 to 1578.5; see Sec. 2.3.5) The District can selectively withdraw water from any single or a combination of these intakes to control water quality. During normal operations, most downstream flow is obtained from the water quality control intakes. The location and operation of these gates is an important consideration in this EA because their operation affects lake and downstream water temperatures, downstream water quality, and all aquatic life, found both in the lake and downstream.

Photo 7 (right) looks upstream into the barrel tunnel that discharges reservoir flow. This discharge is located at the downstream face of the dam at the right abutment.

2.3.4 Summary of Seasonal Reservoir Operations

The elevation of the reservoir behind the dam is seasonally adjusted throughout the year to best meet authorized purposes. The minimum pool (defined as the level at which there is a negligible volume of water-storage capacity) would be at El.1555, with a full pool at El.1685 (130 feet higher), which corresponds to the top elevation of the spillway weir (see Sec. 2.3.2). With a minimum pool, the dam would be operated where the outflow from the control tower would equal the inflow into the lake. Under average operating conditions, the maximum summer conservation level would be at El.1670 (**Note:** this level lowered to El.1650 for the interim, see Sec. 2.5). This maximum summer pool is usually reached by 1 May and typically maintained until 10 June, when water is released to augment downstream flow and improve water quality, resulting in the pool level falling to the maximum winter conservation level of El.1651 (**Note:** this level lowered to El.1623 for the interim, see Sec. 2.5) by 5 September. The maximum winter conservation level of El.1651 (interim level El.1623) is then maintained until 1 March, at which time, spring filling normally occurs until El.1670 (interim level El.1650) is attained on 1 May.



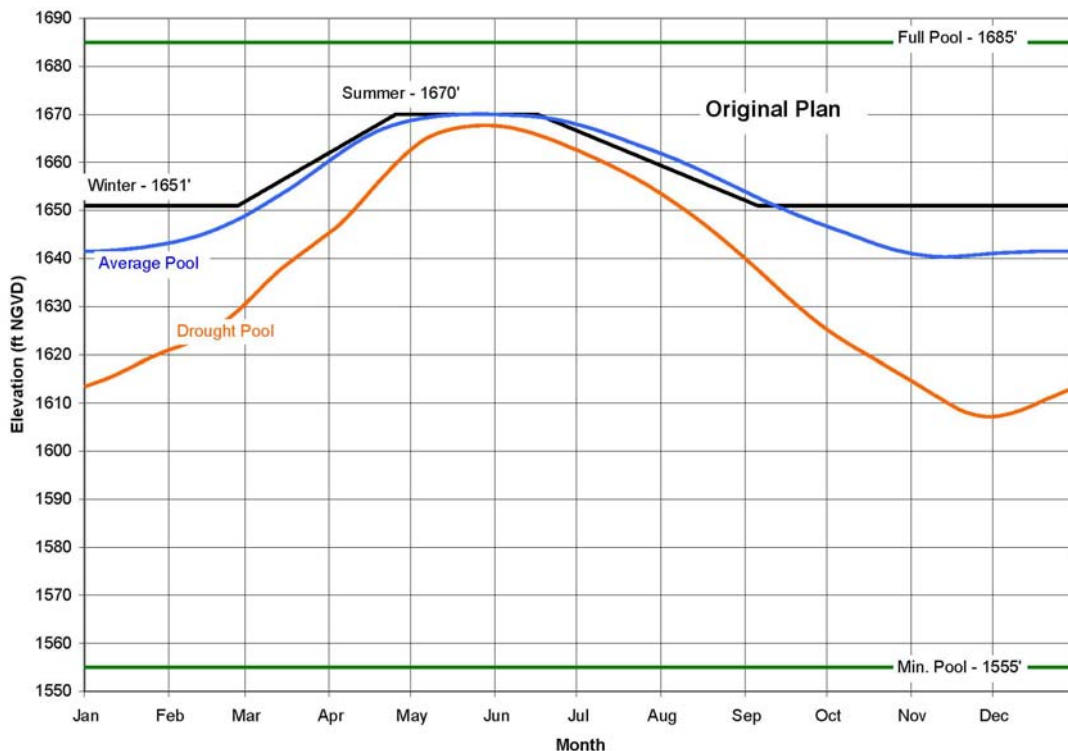
(**Note:** The maximum summer and winter conservation pool levels of El.1670 (interim level El.1650) and El.1651 (interim level El.1623), respectively, are maximum “target” elevations. The operation of the reservoir causes the levels to fluctuate either higher or lower depending upon meteorological conditions and downstream flow requirements.)

A simple graph shown below (**Fig. 3**) depicts the average pool operations. The graph shows how the monthly pool elevations vary over a one-year time period for both average and dry conditions. The blue line depicts pool elevation for average conditions, the orange line

represents the pool levels during dry conditions, and the black line represents the target pool elevations. The horizontal green lines depict the maximum (totally full) pool at El.1685 and minimum pool at El.1555.

Drawdown to meet downstream low-flow augmentation requirements (during the drier summer and fall) normally begins mid-June at El.1670 (interim level El.1650) and ends in mid-November at El.1640. Although the maximum winter conservation pool of El.1651 (interim level El.1623), is normally reached by 5 September each year, the pool elevation is frequently lower due to downstream low-flow requirements. Downstream low-flow augmentation schedule is *always* given priority over managing East Branch Lake elevations. Low water releases range from 80 to 220 cubic feet per second (cfs) during the average drawdown period.

Figure 3 – Authorized Water Control Plan



2.3.5 Outlet Modification to Improve Water Temperature Management

Water temperature management in the late summer/early fall is critical to the operation of the Domtar Mill, the lake trout fishery in East Branch Lake, and the cold water trout fishery downstream in the East Branch Clarion and Clarion Rivers. Because of the higher in-lake and colder release water temperature problems encountered in the summer of 2008, the District assembled an ad-hoc study team to determine if a practicable method could be implemented to allow more normal temperature releases while operating at a lower 1650 interim pool.

The District considered several alternatives to keep cold bottom water in the lake through the late summer/early fall when critically needed to maintain the lake trout fishery and discharge warmer surface waters to avoid stressing the downstream fishery with water that is too cold. The end result of this investigation was the design and installation of a metal “U” shaped intake extension that effectively added another “intake” opening in the water control tower. This extension was bolted to the front of the control tower over one of the gate intakes at El.1552 to allow water to be withdrawn from upper warmer levels of the reservoir at El.1578.5 after the 1620 intake goes out of service, due to the lowering of the pool, as required under the new interim operating plan.

Intake No.1 would go out of service in late September, under average conditions, and around mid-August during a drought. Until the intake extension at El.1578.5 was installed, in October 2008, colder bottom water had to be released from the 1552 intake after the 1620 intake went out of service. When the pool goes below El.1620 now, the extension permits blending of warmer surface water with colder bottom water to better control the temperature of both lake and downstream releases. The extension permits water to be taken from El. 1578.5 until the usual mid-October change to total cold water releases from the 1552 gate (intake #3) is required.

With the intake extension in operation, July and August releases will only be about 5 degrees higher than normal, and September releases will be about 5-8 degrees cooler than normal. During the rest of the year, the temperature of the lake and downstream releases should be very close to historical values. This modification will ensure that temperature extremes, like those encountered late summer 2008, will not occur for the life of the 1650 interim operating pool.

2.4 History of Dam Seepage

All dams have seepage as impounded water seeks paths of least resistance through the dam and its foundation. Seepage must be controlled to keep a dam safe; if uncontrolled, it can lead to piping, which is the serious condition of internal erosion or movement of water-borne soil materials through a dam. Piping can eventually cause the gradual uncontrolled release of the reservoir or cause a dam to fail if not corrected. East Branch Dam has a history of seepage problems which are described below.

2.4.1 Left Abutment Seepage Incident

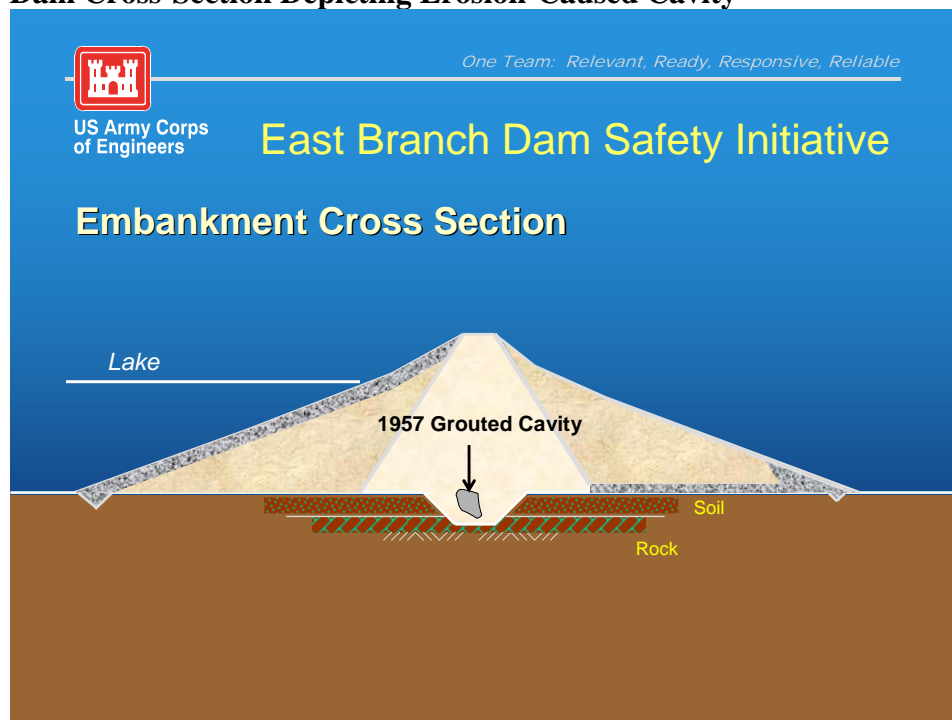
In 1953, the District determined that some seepage was occurring near the left abutment of the dam. The District judged that the seepage path was either a continuous open joint in bedrock or a series of interconnecting joints through a sandstone layer in the left abutment. The District attempted to rectify this problem using grout holes drilled radially into broken rock strata. This work was completed in January 1956. This grouting work was only partially successful and considerable seepage continues from the left abutment

2.4.2 Right Abutment Seepage Incident

The dam experienced a serious seepage incident in 1957. On 8 May 1957, the reservoir manager reported seeing muddy water flowing from the rock drain at the downstream toe of the dam in the original stream channel. Further analysis and core drilling in May 1957 revealed the presence of a significant void within the core of the dam created by internal erosion. See **Fig. 2**, above, showing the core and **Fig. 4**, below, depicting a cavity within the core. Internal erosion left untreated could have caused East Branch Dam to fail. Consequently, given this void's size

and the accelerating rate of erosion that was occurring, emergency action was taken and the pool was drawn down from summer pool (approximately El.1670) to near minimum pool (El.1555). This action minimized the static load on the dam to ensure it would not fail. Emergency repairs were made, lasting from June until November 1957. The repairs consisted principally of filling the void with grout and consolidation grouting the surrounding area of soft embankment soils. Because of this incident's seriousness, a number of monitoring instruments (piezometers) were installed in the area of the repaired void and elsewhere on the dam to monitor internal seepage pressures within the dam's interior. (**Note:** a piezometer is a small-diameter water well used to measure the water level within the dam or its foundation.) These instruments have been closely monitored since 1957. The dam has performed safely since this incident, including during the maximum pool of record that occurred in 1972 from flooding caused by Hurricane Agnes. During this storm, water discharged through the spillway.

Figure 4 – Dam Cross-Section Depicting Erosion-Caused Cavity



2.4.3 Recent Risk Analyses

Almost 65 percent of the dams managed by the U.S. Army Corps of Engineers across the United States are over 30 years old, and 28 percent have reached or exceeded their 50-year design life. Many of these structures are in need of major repair or rehabilitation to ensure their continued safe operations in the future. The Corps' foremost concern is managing the risks for its dams and protecting the public against the devastation that would be caused by dam failures.

Because the Corps is responsible for the safety of approximately 600 dams, a method was needed to prioritize site-specific dam safety investigations and dam safety improvement investments. To this end, the Corps initiated a Risk Analysis for Dam Safety Program to aid in allocating investments to improve the safety of the large number of dams for which it is responsible. The program has an initial screening-level evaluation called the Screening Portfolio

Risk Analysis (SPRA). The SPRA relies on experts to assess the risk of dams in terms of scripted criteria, based on available information.

East Branch Dam was screened in 2006 as part of the Corps' SPRA. This process rates dam safety by categorizing them in the following five Dam Safety Action Classes:

- DSAC I – URGENT AND COMPELLING (Unsafe)
- DSAC II – URGENT (Unsafe or Potentially Unsafe)
- DSAC III – HIGH PRIORITY (Conditionally Unsafe)
- DSAC IV – PRIORITY (Marginally Safe)
- DSAC V – NORMAL (Safe)

As a result of the SPRA, East Branch Dam was classified as a DSAC II. A primary reason for this classification was concern over the structural integrity of the 1957 repair near the right abutment. East Branch Dam is the only reservoir dam in the Pittsburgh District to receive this rating. A dam with this classification is considered to have failure initiation foreseen or very high risk. Foreseen failure initiation means the dam has confirmed and/or unconfirmed safety issues, and failure could begin during normal operations, or from a flood or earthquake event.

2.5 Summary of Interim Risk Reduction Measures

In response to the risk assessment conducted by the Corps and Bureau of Reclamation in 2008, the District implemented various interim risk reduction measures (IRRM). The primary IRRM was implementation of an interim water control plan which lowered the summer pool to El.1650 and the target winter pool to El.1623. Lowering the summer pool by 20 feet and the winter pool by 28 feet has reduced the hydraulic load on and within the dam to allow risk-improved operating conditions for an interim period until the long-range strategy is developed and implemented, while avoiding significant impacts either within the lake or downstream.

The Pittsburgh District also implemented the following secondary measures to closely monitor the areas of concern and to take rapid action upon evidence of initiating events (thereby either preventing or, more likely, reducing consequences of dam failure). The secondary measures:

1. Implement an extensive communication plan to keep stakeholders and public informed of activity at East Branch Dam.
2. Enhance and prioritize existing instrumentation and obtain critical instrumentation readings more often to better monitor the condition of the dam.
3. Implement cross-training of regional staff to support staff at the dam.
4. Initiate 24-hour staffing to monitor the condition of the dam.
5. Update the existing Emergency Action Plan to re-evaluate emergency procedures and update calling tree.
6. Develop new inundation mapping to better define the floodway downstream of East Branch Dam.
7. Conduct drills and exercises to better educate staff and local emergency management personnel.
8. Pre-position contracts/materials for emergency response and improve lighting systems.

The Environmental Assessment (EA) describing the District's decision process in determining this interim operational policy was circulated for public review in May 2009, and the Finding of No Significant Impact (FONSI) was signed 15 June 2009 (see Appendix A). As of November 2009, all of these secondary IRRM measures have been fully implemented. These measures will be reviewed annually or as new information becomes available. The District will change or add to these secondary IRRMs, as warranted, until a permanent risk reduction measure is in place.

Under the new interim operating schedule, there will be no changes made to the originally authorized downstream release schedule, unless there is no reservoir storage available, due to drought. The pool will simply be operated at a lower level. Continuation of the current release schedule is considered a high priority in order to provide necessary flows to all downstream water users, including a paper mill at Johnsonburg, the City of Ridgway, and a peaking hydroelectric plant near Clarion, and also to protect water quality and aquatic life. Annual benefits related to recreation are reduced with these new pools, and commercial and industrial benefits are now susceptible to reduction during drought periods.

2.6 Contaminated Material Encountered while Boring Monitoring Well

Liquid free-product was encountered at a boring on the downstream slope of the dam, near the left bank, subsequent to an attempt to conduct permeability testing of bedrock (using pressurized water) during subsurface exploration on 12 May 2009. ("Free-product" means petroleum product in excess of 0.1 inch, measured at its thickest point, floating on the surface of surface waters or groundwater.) Once this material was encountered, drilling and testing activities ceased, and the steel casing used to advance the boring was left in place to avoid any further distribution of free product. Mr. Robert Short of D'Appolonia collected a sample from the boring using a dedicated bailer, and decanted the water out of the sample prior to placing the recovered free product oil into sample jars. The samples were delivered to Weavertown Environmental, and under proper chain-of-custody procedures, sent to Precision Analytical, Inc., to be analyzed for polychlorinated biphenols (PCBs), BTEX, and Flashpoint. Based on the results of the analytical report, the material was contaminated, but considered non-hazardous.

(**Note:** the borehole was filled with a non-shrink grout from borehole bottom to the surface, with the borehole fluids [i.e., water and free-product] collected in a steel barrel. The steel casing was abandoned in the borehole to prevent release of free-product into the groundwater or river.)

It is believed that the proposed monitoring well boring (08-EBD-78A) was placed directly over a historical oil well (for more details, see Sec. 4.3 Geology/Soils, and Sec. 4.17 HTRW).

D'Appolonia concluded that they may have pressurized a zone within the rock formation that was filled with oil/gas from this historic well. This was corroborated by the observation that no free product was encountered in the rock core samples, which were retrieved during drilling prior to the attempted permeability testing. In addition to the USACE, the Pennsylvania Fish & Boat Commission and the Northwest Region Pennsylvania Department of Environmental Protection (PADEP) were notified of the encounter. PADEP Inspector Mr. Doug Welsh provided detailed instructions as to the proper retrieval and disposal of remaining free product, and procedures for abandonment of the well location. Inspector Welsh clarified that boring 08-EBD-78A was not subject to either the Oil & Gas Act or Dam Safety Act of Pennsylvania.

3.0 Dam Safety Modification Alternatives, including "No Action"

The District formulated several dam safety modification alternatives that include non-structural measures (hereafter NS#) and structural modifications (hereafter S#), ranging from maintenance of current IRRMs in perpetuity (used here as the “No Action” alternative) to full removal of the dam. The alternatives considered are summarized below:

NS1 – makes permanent all current IRRMs (interim pool elevations: El.1650 summer, El.1623 winter). (**Note:** considered as the “No Action” alternative; see Sec.5.2.)

NS2 – incorporates all current IRRMs and lowers spillway to El.1668.

NS3 – all intake tower gates permanently opened, resulting in pool elevations varying between 1531 (normal) and higher, resulting from precipitation events (on average, the pool would rise to El.1550 at least once annually), also lowers spillway to El.1668.

S1 – full-depth into bedrock; impermeable, concrete cut-off wall constructed near dam’s centerline, along right abutment; requires 12 miles of drilled secant shafts.

S2 – combination wall consisting of a cut-off wall over full length of embankment only to top of bedrock, combined with intensive grouting of foundation rock beneath the cut-off; no secant shafts drilled.

S3 – full-depth into bedrock; impermeable cut-off wall near dam centerline, over full length of embankment; would require about 50 miles of drilled secant shafts.

S4 – embankment extension immediately downstream of existing dam, using top portion of dam for fill material, and additional fill from nearby hillside; coupled with a full-depth cut-off wall at the toe of the existing dam, would require about 28 miles of drilled secant shafts.

S5 – downstream concrete gravity structure, positioned near the downstream toe of the existing dam to preserve the existing emergency spillway. The structure would include a dam drainage gallery and foundation grout curtain for seepage control.

S6 – removal of dam, ensuring run-of-river conditions at all times.

(All alternatives described in more detail below.)

3.1 Plan NS1 - All current IRRMs made permanent

NS1 would make permanent all IRRMs at East Branch Dam described in Sec. 2.5, including target pools of 1650 for summer and 1623 for winter. Considered the “No Action” alternative;” see Sec. 5.2)

3.2 Plan NS2 - Incorporates current IRRMs & lowers spillway to El.1668

NS2 incorporates all IRRMs and lowers the spillway to El.1668. Elevation 1668 was chosen as the new spillway elevation, in order to prevent pool levels from exceeding the currently authorized summer pool of 1670 for all but the most extreme hydrologic events, while maintaining flood protection for storms less than 100-year storm events; consistent with original levels of flood protection.

3.3 Plan NS3 - All intake gates permanently opened & lowers spillway to El.1668

NS3 was developed to represent the most drastic pool lowering possible, short of removing the dam (considered a structural plan and addressed below) where all intake tower gates are permanently opened. The large sluice gates located at the bottom of the control tower at El.1531 would be permanently raised fully open to eliminate the pool. The flood gates would not be operated during high water events. While the river behind the dam could fall to El.1531 during normal conditions, during precipitation events it is expected that the river level would rise to at least El.1550 in an average year. As with Plan NS2, the spillway is lowered to El.1668. Because Plan NS3 represented the most drastic pool lowering, evaluating the risk of this plan demonstrated if there were any permanent pool lowering that was acceptable.

3.4 Plan S1 - Full-depth cut-off wall, right abutment, with grouting & secant shafts

S1 was formulated based on the U.S. Bureau of Reclamation’s analysis and focuses on the right abutment. A positive (impermeable) concrete cut-off wall would be constructed near or slightly upstream of the dam’s centerline, along the right abutment. The full-depth cut-off wall would extend nearly 500 feet from the right abutment contact to the tallest portion of dam near the center of the valley. In addition, grouting of rock would be done along a line near the downstream right abutment. This downstream return is intended to impede hillside seepage and reservoir leakage from entering and damaging the downstream zone of the dam. The wall sections would be constructed with a panel wall (excavated through soil into the top of rock using a hydromill), with secant shafts extending through the panel wall into bedrock. The bottom of the cutoff was assumed to terminate at El.1400. This is based on a conservative interpretation of Lugeon (permeability) testing done recently at the site. It is estimated that about 12 miles of drilled shafts would be constructed as part of Plan S1.

3.5 Plan S2 - Combination wall, full length of embankment, with grouting

S2 involves what is being termed a combination wall. This wall consists of a cut-off wall over the full length of the embankment only to the top of bedrock, combined with intensive grouting of the underlying bedrock (to the same depth limits in rock for Plan S3.) This plan includes the zone of rock grouting along the downstream right abutment contact, as described for Plan S1. No secant shafts would be required for this plan. This plan relies on intensive grouting of in-situ rock to form a permanent cut-off in bedrock. The bottom of the grouted bedrock wall was assumed to be less deep at the left abutment.

3.6 Plan S3 - Full-depth cut-off wall, full length, with grouting & secant shafts

S3 extends the full depth cut-off wall over the full length of embankment and includes the zone of rock grouting along the downstream right abutment contact to address seepage re-entry into the embankment. This plan would be constructed similarly to the partial cut-off wall (S1). About 50 miles of drilled secant shafts would be required for this plan. As with Plan S1, the bottom of the cutoff near the right abutment was assumed to terminate at El.1400. The bottom of the cutoff wall was assumed to slope up incrementally to the left abutment, where it is expected that rock joints are less extensive and severe than at the right abutment where valley stress relief (geologic) is believed to have been more acute.

3.7 Plan S4 - Embankment extension immediately downstream of existing dam

S4 involves construction of an embankment extension immediately downstream of the existing dam. A portion of the top of the dam would be removed and used for fill material. A substantial volume of additional fill material would be obtained from a nearby hillside. Obtaining that fill material would require a temporary borrow area easement on one tract of land totaling approximately 72 acres. A core wall (constructed concurrently with embankment construction near the newly aligned centerline of the crest) would be integrated with a foundation cutoff wall to complete the seepage cut-off system. A downstream filter zone would be integrated with a blanket drain downstream of the core wall. The foundation cutoff wall would consist of secant shaft elements extending through the overburden soil and underlying rock. It is perceived that construction of a panel wall using a hydromill would not be feasible given the terrain over which the equipment would need to be situated and inherent curvature in the wall's alignment. The bottom elevation of the cutoff wall would be the same as for Plan S3. About 28 miles of drilled shafts would be involved with this plan. The existing outlet works and spillway would be retained; however, the outlet works would require modification. The outlet tunnel would be extended by constructing a conduit approximately 600 feet downstream to the toe of the embankment extension and constructing a new stilling basin. This modification would involve maintaining outflow during construction.

3.8 Plan S5 - Downstream concrete gravity structure near toe of existing dam

S5 would involve the construction of a concrete gravity structure, positioned near the downstream toe of the existing dam to preserve the existing emergency spillway. The structure would include a dam drainage gallery and foundation grout curtain for seepage control. Extension of the outlet tunnel and construction of a new stilling basin would be required.

3.9 Plan S6 - Removal of dam

S6 would involve removal of East Branch Dam to the extent necessary to ensure run-of-river conditions at all times. A significant portion of the embankment would be removed and stable slopes created on what remained of the embankment. The excavated fill would be placed in upland disposal areas and disturbed areas would be re-vegetated.

3.10 Summary of Formulated Plans

All plans are briefly summarized below, along with their screening level cost estimates.

Table 1 – Summary of Preliminary Plans

Plan	Non-Structural Measures	Structural Measures	Costs
NS1*	All IRRM (Summer Pool El.1650) Considered the “No Action” Alternative.	None	\$7,470,000
NS2	All IRRM (Summer Pool El.1650)	Lower Spillway	\$10,000,000
NS3	All IRRM + Open Gates (No Pool)	Lower Spillway	\$18,830,000
S1	Consider relaxing or eliminating IRRM if risks are acceptable.	Partial Full-Depth Cut-off Wall on Right Side of Dam	\$111,820,270
S2	Same as for S1.	Full Length Combination Wall (Cut-off Wall to Top of Rock with Foundation Grouting.)	\$139,240,000
S3	Same as for S1.	Full Length Full Depth Cutoff Wall with Foundation Grouting	\$284,300,000
S4	Same as for S1.	New Embankment and Appurtenant Features Downstream of Existing Dam, Core Wall & Foundation Cut-off	\$449,970,000
S5	None	Construct Concrete Gravity Structure Immediately Downstream of Existing Dam	\$639,000,000
S6*	None	Remove Dam	\$52,120,000

*Denotes Required Plan

3.11 Evaluation Criteria and Initial Screening of Formulated Plans

3.11.1 Evaluation Criteria

Formulated plans were subjected to a risk-based evaluation in accordance with Corps' practice. Those plans found to result in acceptable levels of risk were carried forward and compared with each other to determine which plan was most favorable. Comparison criteria included: completeness, effectiveness, efficiency, acceptability, implementation cost, and economic and environmental impacts. The plan determined to best address these criteria was selected for recommendation as the preferred plan.

3.11.2 Initial Screening of Formulated Plans

Risk analyses indicated that Plans NS1 and NS2 did not meet the Corps' tolerable risk guidelines. (**Note:** Plan NS1, however, was considered acceptable for use as the "No Action" alternative; see Sec. 5.2 for explanation). Plan NS3 met the Corps' risk guidelines; however, it did not return the project to its originally authorized purposes, i.e., it eliminated a considerable portion of the flood control benefits, all of the low-flow augmentation required downstream by industry, and all water quality considerations for fish habitat. Thus, Plans NS1, NS2, and NS3 were eliminated from further consideration as viable alternatives.

Risk analyses also indicated that Plans S1 and S2 did not meet Corps' tolerable risk guidelines. Plan S1 would not address the risks posed by seepage at the left abutment. Plan S2 would attempt to create a cutoff within bedrock through intensive grouting; yet, analyses determined that although grouting would ameliorate seepage, it would not be sufficiently effective creating a complete cutoff. Thus, Plans S1 and S2 were also eliminated from further consideration.

Plans S3, S4, S5, and S6 would all lower the risk associated with dam failure at East Branch Dam to acceptable levels, based on the Corps' tolerable risk guidelines. Thus, these four plans are all technically acceptable. (**Note:** regarding Plan S6, however, a structure that no longer exists cannot fail; implementation of Plan S6 would expose the downstream population to some amount of increased risk due to flooding. The existing dam currently provides substantial flood protection to the public, which is one of the authorized purposes.) As formulated, however, these four plans satisfy Corps' requirements, since at least one meets tolerable risk guidelines. All of these plans (S3-6) represent the second iterative screening assessment phase.

3.12 Assessment of Final Structural Plans

Table 2 (below) includes the second phase of the iterative screening assessment, considering: economic viability, engineering feasibility, and socially and environmentally acceptable parameters that must be evaluated for the remaining technically acceptable plans.

Table 2 – Assessment of Final Plans

Parameter	Plan S3	Plan S4	Plan S5	Plan S6
Meets Corps' tolerable risk guidelines?	Yes	Yes	Yes	Yes
Preliminary cost estimate.	\$285 Mil	\$450 Mil	\$639 Mil	\$52 Mil
Environmental consequences	See Table 3	See Table 3	See Table 3	See Table 3
Compliance with Corps' essential guidelines	Yes	Yes	Yes	Yes
Societal concerns based on community consultation. Will elaborate in NEPA process.	No	No	No	Yes
Completeness ¹	Yes	Yes	Yes	Yes
Effectiveness ²	Full	Full	Full	Full
Efficiency Ranking ³	1	2	4	3
Acceptability ⁴	Yes	Yes	Yes	Yes
RRR ⁵	Yes	Yes	Yes	N/A

¹ Extent to which the plan provides and accounts for all necessary investments or other actions to ensure the realization of risk reduction objectives, including actions by other Federal and non-Federal entities.

² Extent to which the plan contributes to achieving the objectives.

³ Extent to which the plan is the most cost effective means of achieving the objectives.

⁴ Extent to which a plan is acceptable in terms of applicable laws, regulations and public policies.

⁵ "Robustness, Redundancy, and Resilience."

Environmental Parameters	Alternative S3 – Full Depth/Full Length Cutoff Wall + Grouting	Alternative S4 – Dam Extension Immediately Downstream+Fortification	Alternative S5- Concrete Gravity Structure	Alternative S6- Remove Dam
Public Health and Safety	Dam can operate safely and flood control benefits are maintained during construction. Dam will be made safe for the foreseeable future.	Flood control benefits maintained during construction. The new embankment will be safe for the foreseeable future.	Flood control benefits maintained during construction. The new structure will be safe for the foreseeable future.	No dam. 100 percent loss of flood control benefits.
Lake Water Quality	No significant effects during construction. New chute will help maintain optimum lake temperatures.	No significant effects during construction. New chute will help maintain optimum lake temperatures.	No significant effects during construction. New chute will help maintain optimum lake temperatures.	No lake.
Downstream Water Quality	No significant impacts during construction.	No significant impacts. Controls and good engineering practices to limit downstream turbidity during construction will be implemented.	No significant impacts. Controls and good engineering practices to limit downstream turbidity during construction will be implemented.	Severe effects. No low-flow augmentation; loss of all AMD dilution provided by lake; increased sedimentation from erosion of exposed lake sediment.
Lake Fishery	Cold water lake fishery will be maintained during construction.	Cold water lake fishery will be maintained during construction.	Cold water lake fishery will be maintained during construction.	No lake – total loss of lake fishery.
Downstream Fishery	No significant impacts.	Loss of at most 600 feet of East Branch Clarion River habitat to place new embankment and extend control tower outlet.	Loss of at most 600 feet of East Branch Clarion River habitat to place new embankment and extend control tower outlet.	Severe effect. Partial loss of cold water fishery due to lack of low-flow augmentation. Severe impacts to remaining downstream cool and warm water fisheries during high precipitation events that will wash accumulated lake bottom sediment downstream and undiluted AMD pollution.
NPDES Permit Holders	No effects	No effects	No effects	No effects during average precipitation Severe effects during drought. One firm affected for 200 days, Johnsonburg and Ridgway STP's affected for 175 days and PA American affected 160 days.
Socio-Economics and Recreation	Full restoration of authorized benefits. Average annual benefits = \$81.9 million.	Full restoration of authorized benefits. Average annual benefits = \$81.9 million.	Full restoration of authorized benefits. Average annual benefits = \$81.9 million.	Permanent loss of annual benefits = \$52.8 million. Average remaining annual benefits = \$29.1 million.
Wild and Scenic River Status	No effect	No effect	No effect	Severe effect due to loss of all low-flow augmentation and attendant water quality degradation from industry and acid mine drainage and sediment

Parameters	Full Depth/Full Length Cutoff Wall + Grouting	Extension Immediately Downstream+Fortification	Concrete Gravity Structure	Remove Dam
Wetlands	Temporary increase in lake area wetlands until dam is repaired and the lake is raised to its authorized levels. Downstream wetlands will not be affected.	Temporary increase in lake area wetlands until dam is repaired and the lake raised to its authorized levels. Downstream wetlands will not be affected.	Permanent increase in lake area increasing potential for wetlands with re-establishment of new wetlands in the pool area where old dam is.	Permanent loss of lake area wetlands with re-establishment of new wetlands along the river in the pool area. New lake area and downstream wetlands will establish based upon land morphology and the hydrology associated with uncontrolled flow.
Endangered Species	No effect	No effect	No effect	Loss of all low-flow augmentation may impact state-listed species in the lower Clarion River due to water quality degradation.

The first step in evaluating the four remaining plans was comparing effects to the baseline condition. The primary benefit of these plans is the virtual elimination of the high annual probability of failure (APF) of the dam. The potential for loss-of-life in the baseline is relatively significant; however, the APF and estimated average annual loss-of-life values would be sufficiently reduced with all four final plans. (**Note:** Plan S6 would result in the permanent loss of about \$53 million in annual benefits, as flooding would become more frequent. The life-loss implications of this have not been evaluated, but this would diminish the effectiveness of Plan S6, in comparison to Plans S3, S4, and S5.) All four plans would essentially avoid all economic and temporary environmental impacts incurred during inundation of a dam breach.

The second step was to compare the final plans with each other. In order to assimilate the various data included in **Tables 2** and **3**, rating criteria were established, including engineering, economics, and environmental considerations, and the plans compared against these criteria. Plan S5 is superior in terms of risk reduction, while Plans S3 and S4 are similar. Therefore, other considerations, with respect to economic and environmental factors, are necessary in determining the preferred plan. Construction costs for Plans S3, S4, and S5 are higher than Plan S6, but a large portion of the annual benefits are permanently lost with S6 (dam removal). Further, there are severe environmental effects with Plan S6, attributable to permanent loss of the reservoir, including severe impacts on downstream water quality and fishery, as well as impacts to downstream NPDES permit holders. It is anticipated that downstream users would be required to make major investments to preserve water supplies, possibly including additional dam construction to create impoundments. In addition to high costs, such investments would require long time horizons. Factors including permit requirements, exploration and engineering design, and real estate would require consideration. Removal of the dam would likely be delayed to allow for the completion of such investigations; thus, the duration to complete Plan S6 is expected to be greater than eight years. Consequently, based on economic and environmental considerations, Plan S6 is considered inferior to Plans S3-5, and is therefore eliminated.

Final comparison between Plans S3, S4, and S5, revealed that implementation of S3 could be accomplished several years sooner, which would lower overall risk. A more in-depth design and analysis would be required with Plans S4 and S5, as compared to Plan 3. In terms of economics, all three plans qualify for the best category. The environmental impacts, however, favor Plan S3, since both S4 and S5 involve a loss of East Branch Clarion River habitat area, due to the extended footprint of a new dam and extended outflow tunnel. Finally, the public would obtain the same benefits from each plan, but Plan S3 costs the least. In light of these many advantages, Plan S3 is recommended as the preferred plan.

4.0 Existing Environmental Conditions

4.1 Land Use

The project area in northwestern Pennsylvania is rural in character and largely forested. Starting from furthest upriver along the East Branch Clarion River, below East Branch Dam, small communities include: Glen Hazel and then Johnsonburg at the headwaters of the Clarion River where the East Branch joins the West Branch forming the Clarion. Downstream, along the Clarion River, are the communities of Ridgway, Portland Mills, and Clarion (see **Fig. 5**, below).

In regard to land use, Bendigo State Park is located along the left bank of the East Branch of the Clarion River, from East Branch Dam, down to the Clarion River, and well past Portland Mills; mostly along left banks. The Clarion River is bordered by the Allegheny National Forest (ANF) along its right bank, from about Ridgeway on past Portland Mills, and by State Game Lands 25, 44, 54, 283, 74, and Clear Creek State Park and Cook State Forest, just downstream of the ANF. The largest industrial facility in the area is the Domtar paper mill located in Johnsonburg.

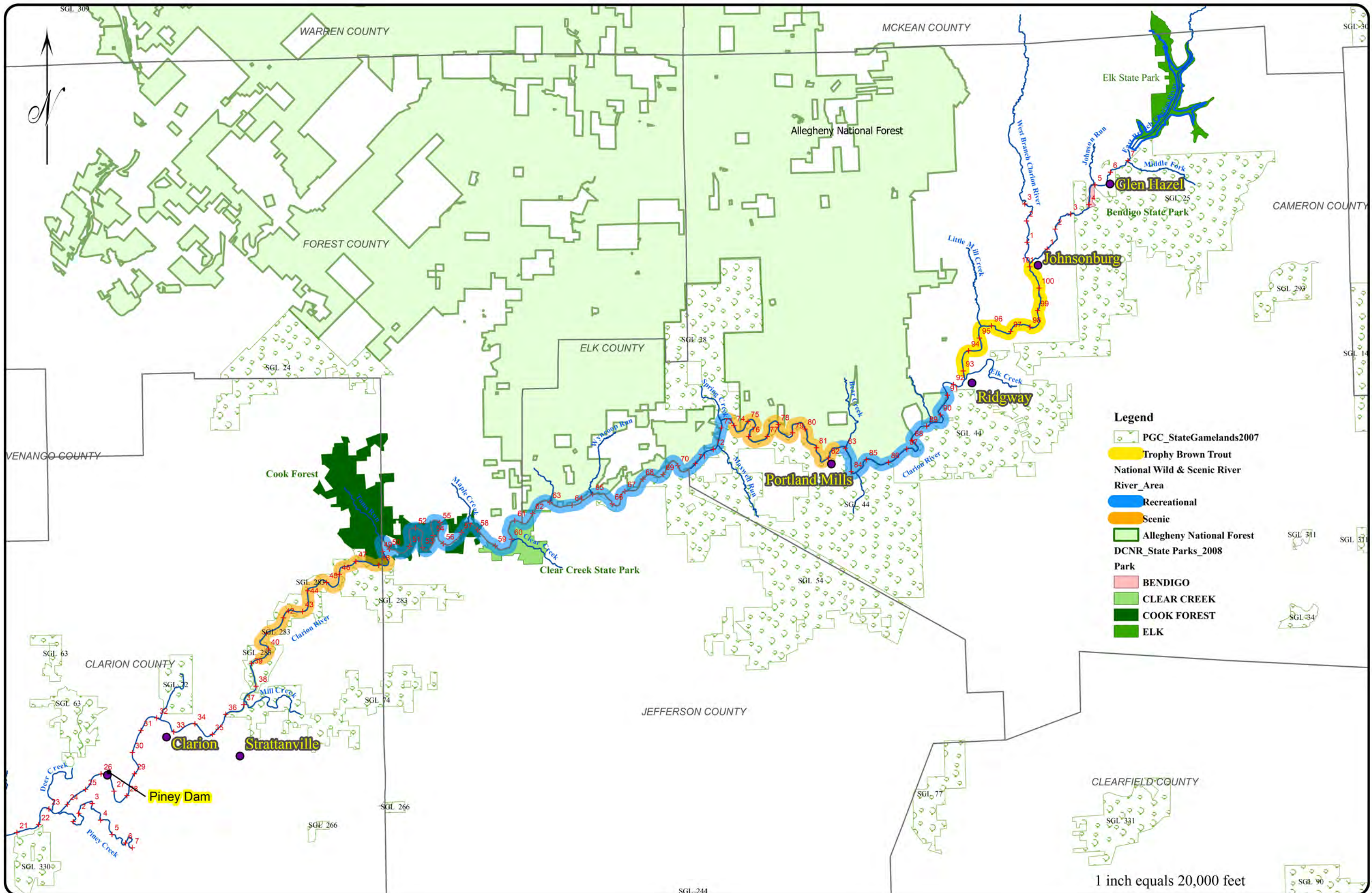
4.2 Physiography

Average basin relief above East Branch Lake is 400 to 500 feet. Elevations in the basin range from the streambed elevation of 1525 feet at the dam to 2250 feet NGVD along the northern ridge boundary. The East Branch Clarion River headwaters are flat, marshy, and sluggish along the north and west ridges. The banks of the East Branch River vary in height from seven feet in the vicinity of the dam to two feet in the headwaters. The banks of the tributaries are proportionally less in height with narrower valleys in the middle reaches.

4.3 Geology/Soils

Bedrock in the site of East Branch Dam is composed of shales and sandstones of the Pocono, Mauch Chunk, Pottsville, and Allegheny formations of the Mississippian and Pennsylvania series. The sandstones are generally fine to medium grained while the shales tend to be silty. Structurally, the formations are well jointed and essentially flat with a maximum dip of about three percent from the left abutment upstream and toward the right abutment. All the rock contains fractured surfaces which can be weathered to depths of 160 feet. Deep and open vertical fractures were observed during the construction of East Branch Dam and were reportedly continuous from the upper abutments down to the valley (the deepest center point of original stream channel). The rock formations are situated on the western flank of the Hebron Anticline (an upward fold of stratified rock) and have been deformed into a series of northeast-trending gentle folds.

The reservoir valley lies south of the glacial terminus and was probably eroded during glacial time to a depth of about 40 feet below the streambed. The valley was refilled with soil deposits eroded from the valley walls, which are part colluvial (soil movement down from steeper slopes) and part alluvial (soils deposited by water). These deposits are poorly stratified and contain materials ranging in size from silt with traces of clay to large blocky boulders of sandstone. The only strictly alluvial materials were found in the middle of the valley and generally consist of fine to coarse sand with some fine gravel and a small amount of silt. The types of soils along the East Branch Clarion and Clarion Rivers vary depending upon location and slope conditions. Generally, along the steep slopes, soils are moderately deep, well drained and were formed from



Area Map

Figure 5

weathered sandstone and shale. Along the narrow flood plains, soils are generally acidic, stony silt loams.

A number of oil and gas wells were located at the dam site prior to construction, including the dam foundation area. Complete records pertaining to the plugging of these wells are not available; however, there are references to well plugging activity during dam construction.

4.4 Climate and Hydrologic Data

The climate in the area is humid and temperate with an appreciable variation in temperature. Frequent and rapid changes in weather are due to frontal air mass activity. Prevailing wind direction is from the west or has a westerly component. Temperatures above 90 degrees Fahrenheit in the summer and below 0 degrees Fahrenheit in the winter are recorded normally 11 and 15 days, respectively, per year, with extremes of 103 degrees and minus 37 degrees on record. The mean annual temperature is approximately 47 degrees, and the average frost-free period ranges from 110 to 140 days.

Precipitation is well distributed across the seasons with a normal average totaling about 42 inches annually. The monthly normal is highest in June and July, with about 4.5 inches, and lowest in February, with about 2.8 inches. Average annual snowfall over the basin is about 60 inches. Snowfall frequently remains on the ground during the winter, and East Branch Lake frequently contains an ice cap into March. River stages rise to flood heights at least once during most years. Floods of high magnitude occurred in September 1861, June 1889, March 1913, March 1936, July 1942, November 1950, June 1972, and January 1996. These data indicate that there is a probability of serious flooding during any season of the year. The frequency of flooding is usually the highest in late winter-early spring.

The East Branch Clarion River basin lies in northwestern Pennsylvania and is roughly rectangular in shape, being approximately 10 miles in the longitudinal direction and seven miles in the transverse direction. The basin's drainage area above the dam is 72.4 square miles. The average daily flow released from the dam is 148 cubic feet per second (cfs); average daily minimum and maximum flows are 20 cfs and 1,610 cfs, respectively.

4.5 Terrestrial Biological Resources

4.5.1 Forested Upland and Riparian Areas

The Clarion River drains a mountainous area of the Allegheny Plateau and flows through narrow valleys with steeply forested slopes dominated by almost continuous mature deciduous hardwood and coniferous species. The northern portion of the East Branch Clarion River basin, which includes East Branch Lake, is almost entirely wooded with little development. The southern and western portions of the basin are less rugged and largely devoted to agricultural use. Most of the forest in northwestern Pennsylvania, including the area around East Branch Dam and Clarion River is within the southern edge of the Hemlock-White Pine-Northern Hardwoods region described by Braun¹. The forest within Cook State Forest located about 55 river miles downstream of East Branch Dam intermingles with the Mixed Mesophytic Forest region. The forested area within the Clarion River Basin consists of mature, second-growth northern hardwoods populated by such species as northern red oak, white oak, chestnut oak, red

¹ Braun, E. Lucy, Deciduous Forests of Eastern North America, 1950.

maple, black cherry, beech, sugar maple, yellow birch, tulip tree, sweet birch, white ash and cucumber magnolia. Hemlock is common on moist northeast slopes and white pine is found on drier southwest slopes. The understory is usually limited by the dense canopy and is dominated by such species as eastern hop hornbeam, serviceberry rhododendron, mountain laurel, pin cherry, sassafras, dogwoods, wild hydrangea, viburnums, blueberry and huckleberry. Typical forest ground cover includes wood fern, partridge berry, oxalis, and club mosses. The East Branch of the Clarion River and lake riparian areas are narrow because of the steep topography and are dominated by sycamore, birch, ash, red maple, ironwood, American hornbeam, elms, and silver maple with an understory dominated by witch hazel, alder, dogwood, elderberry, and willow.

4.5.2 Wetlands

Because lake shorelines are steeply sloped and the lake pool elevation varies dramatically year round (more than 20 feet between winter and summer pool elevations with an even greater elevation changes during high runoff events) shoreline wetlands are sparse. Almost all of the lake's wetlands are located at the head of tributary embayments where slopes are gentler and streams can provide wetland hydrology when pool elevations are low, including the East Branch Clarion River inflow, the South Fork of Straight Creek, Straight Creek, and Fivemile Run.

East Branch Lake wetland types include wooded, lacustrine emergent and scrub/shrub, unconsolidated shore and aquatic beds. Subclasses included rooted vascular for aquatic bed, cobble-gravel for unconsolidated shore, persistent and non-persistent emergent wetlands and broad-leaved deciduous forested wetlands. Shoreline wetland community composition is dependent on specific hydrologic regimes created by lake pool elevations. Wooded wetlands are located between 4 and 10 feet above summer pool elevation (El.1670 to 1680); scrub/shrub and emergent wetlands from 10 feet below to 10 feet above summer pool elevation (El.1660 to 1682); unconsolidated shore are located between 5 feet below and 5 feet above winter and summer pool elevations, respectively (El.1645 to 1675); and aquatic beds from 10 feet below to summer pool elevation (El.1660 to 1670). Rooted aquatic vegetation is uncommon around the reservoir. This is due to normal pool fluctuations caused by project operations, lack of shallow water littoral zone, lack of nutrients, and a rocky bottom with little sediment to support root growth.

East Branch Lake is 5.7 miles long and has 20 miles of shoreline at summer pool, but there is less than a mile of emergent and scrub/shrub shoreline wetlands, only a few aquatic beds, and few acres of wooded wetland around the lake area. There are, however, roughly 80 acres of emergent and scrub/shrub wetlands in tributary embayments. Wooded wetlands are dominated by birch, sycamore, and basswood; scrub/shrub and emergent wetlands by willows, alders, dogwoods, buttonbush, spiraea, woolgrass, common rush, knotweeds, swamp milkweed, boneset, spikerush, sneezeweed, St John's wort and marsh purslane; unconsolidated shore by late season annual pioneers; and aquatic beds by pondweeds and water celery. Of significant note, while more than 30 percent of Pennsylvania's vegetation is dominated by non-native species, there is so little disturbance in the Clarion River basin that non-native species are uncommon.

Downstream of East Branch Dam, according to the Fish and Wildlife Service's wetlands mapping web site (<http://www.fws.gov/wetlands/data/>), forested, scrub/shrub and emergent wetlands are present along most of the East Branch Clarion River, just downstream of the dam to near Indian Run confluence to the East Branch upstream of Johnsonburg. The density of these

wetlands reduces downstream from Johnsonburg to Ridgway. Below Ridgway, especially below the confluence of Toby Run, there are relatively few wetlands along the river, downstream to the Allegheny River.

4.5.3 Wildlife

According to the Wild and Scenic River eligibility report prepared by the U.S. Forest Service², wildlife habitat in the Clarion River corridor can be roughly divided between near shore riparian/wetland habitat and upland forested habitat on the steep slopes of the river valley. At least 64 species of mammals, birds, reptiles and amphibians are associated with the wetland/riparian habitat, and as many as 82 species utilize the mature upland forested habitat at some points in their life cycles. The large sections of Federal, and state forest and game lands that border the East Branch Clarion River and Clarion River corridors provide habitat for species less tolerant of human disturbance.

The lands surrounding East Branch Lake also provide a variety of wildlife habitats that support numerous species. Stands of Allegheny hardwoods provide good quantities of food and have a high value for a diversity of wildlife, including game birds, song birds, small mammals, and many woodland amphibian and reptile species.

Mammals are among the most identifiable wildlife associated with the Allegheny hardwood environment. These species also play a significant role in the overall ecosystem. The white-tailed deer is the most popular and abundant large mammal at East Branch Lake. With the large amount of protected land in the vicinity, suitable habitat for the proliferation of white-tailed deer exists, even with moderate hunting pressure in the area. Black bear are also found in the project area. Smaller mammals in the project area may include opossum, squirrels, woodchucks, chipmunks, skunks, rabbits, porcupines, shrews, voles, moles, bats, weasels, mink, beaver, coyotes, fox, mice, muskrats, and raccoons.

There are numerous species of birds, both resident and migratory, that utilize the lands around East Branch Lake and the lake itself. Common bird species may include Baltimore oriole, yellow warbler, great crested flycatcher, red-tailed hawk, wood thrush, and downy woodpecker. Ruffed grouse and wild turkey also use this forest cover type. Abundant cavities that can be produced in hardwood forests are generally lacking at East Branch. (Where available, cavities can provide nest and den sites for squirrels, raccoons, owls, woodpeckers, and various passerine bird species. Cavities are especially valuable if located close to a food source.) The lack of cavities may be attributable to the paucity of oaks and other mast producing trees around the lake. During the spring and fall migrations, the reservoir provides a resting stop for various species of waterfowl, including tundra swans, common mergansers, coots, wood ducks, and Canada geese. Kingfishers and herons are also commonly observed. Many raptors, including bald eagles and ospreys, have been regularly sighted at the lake.

Red spotted newts and northern red-bellied snakes are abundant at the project³. Amphibians and reptiles, such as the slimy salamander, wood frog, and eastern garter snake are also probably

² Clarion River and Mill Creek Wild and Scenic River Eligibility Report, Allegheny National Forest, U.S. Forest Service, Warren, PA, 1996.

³ Master Plan, East Branch Clarion River Lake, USCOE, Pittsburgh District, 1999.

common on project lands, as are various other snake and turtle species. Hellbenders are also found within the tail-water area.

A unique caddisfly, *Rhyacophila vuphipes*, was collected from the outflow area in the fall of 1987. This species was not known to inhabit Pennsylvania before this sighting. Another aquatic insect survey was conducted in the summer of 1994 along Fivemile Run, with five samples collected from June through September. Results of the sampling identified 10 taxa of *Tricoptera* and two specimens of *Ephemeroptera*. The acidic condition at the time of sampling was considered the cause of this relatively low number of taxa and species collected. Over the period of record, as water quality has improved, the percent of pollution-intolerant macroinvertebrate species has increased, both in the lake inflow and outflow. As would be expected, the abundance and diversity of benthic species have increased commensurately with water quality improvements.

4.6 Lake and Downstream Water Quality

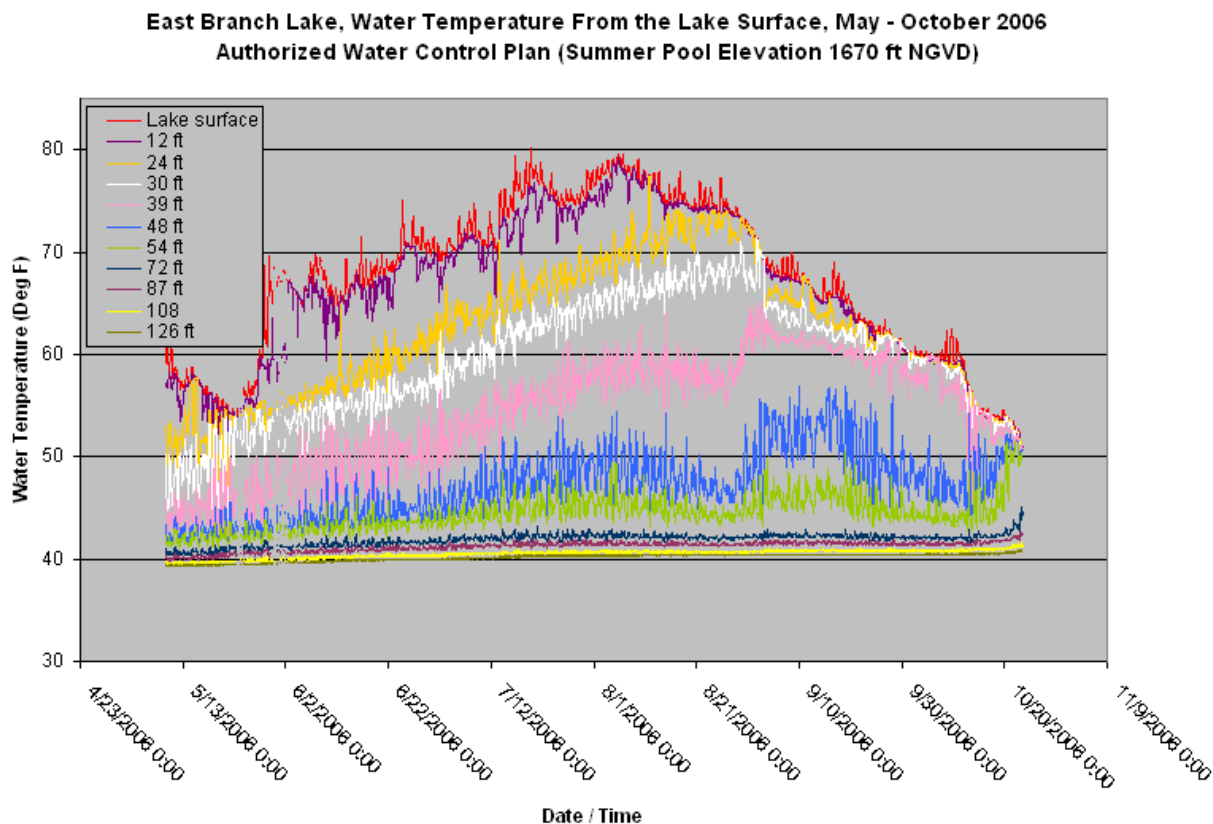
East Branch Lake can be described as a clear, cold, deep and moderately oligotrophic headwater impoundment. The lake is oligotrophic (lacking in plant nutrients and oxygen rich throughout) because of its headwater location; the depth, shape, and geologic base; relatively small drainage area; high degree of forested area and lack of agriculture or other developed lands in the watershed; and historical mine drainage degradation. These factors result in low nutrient loading from the watershed, which limits lake productivity. Cold lake temperatures result from the cool local climate, the elevation of the project, basin topography and forest cover. The elevation of the East Branch Project is the highest of any multi-purpose reservoir in the District and the north to south orientation of the reservoir permits considerable shading by the surrounding hills. The shaded, flat-bottomed, v-shape basin morphology and substantial depth produce rather permanent cold temperatures in the hypolimnion (bottom water strata).

East Branch Lake is a dimictic lake, exhibiting characteristic summer and winter stratification. During the summer months, the lake forms a distinct epilimnion (surface strata), metalimnion (mid level strata) and hypolimnion (bottom strata). This stratification is triggered by the warming of surface waters by summer thermal radiation. The strata are identified by ranges of temperature as depicted in **Fig. 6**. The epilimnion forms from the lake surface to approximately 30 feet in depth, with water temperatures exceeding 68° Fahrenheit (F) near the surface. The metalimnion, which lies between 30 and 50 feet from the surface, is well defined and very stable, established by the elevation of the intake (El.1620) used during the summer season. The reservoir is clear, and light penetrates below the metalimnion. The hypolimnion, generally located 50 feet below the lake surface, remains cold throughout the summer months, where water temperatures in the 80 feet deep strata below El.1610 down to the lake bottom do not usually exceed 43° F. More than 50 percent of the total volume of water in the reservoir is dense cold winter and spring runoff, which is stored in the hypolimnion. During winter, typical inverse stratification develops, in which colder water overlies warmer due to density differences.

Figure 6, below, shows lake water temperatures near the dam between May and October 2006, prior to implementation of the current interim water control plan (El.1650). This location is the deepest section of the lake. Each color-coded, vertical line on the graph represents water temperature at a specified depth from the lake surface. The insert on the upper left side of **Figure 6** shows 11 separate color-coded depths ranging from the surface to 126 feet deep. As

can be seen, the epilimnion was located between the lake surface and 30 feet in depth (between the red and white lines), the metalimnion between 30 and 48 feet (white and blue lines), and the hypolimnion below 50 feet (green line). Summer stratification begins in late April or early May (when the temperature lines are further apart) and usually continues through October. This is an important factor in determining impacts of alternatives as presented later in Sec. 5. Prior to implementation of the current interim water control plan, the lake was most stratified during late July, and the lake hypolimnion remained very cold (37-50° F) throughout the summer season.

Figure 6 – East Branch Lake Water Temperatures



Because of the cold hypolimnetic water temperatures and low primary biological productivity, East Branch Lake remains well aerated from the surface to bottom year round. Dissolved oxygen levels are usually close to saturation in the lake epilimnion and hypolimnion. Lowest oxygen levels in the lake generally occur in the metalimnion layer, from July-September, but levels are still adequate to support fish and other aquatic life.

All of the storage in East Branch Lake is exclusively dedicated to downstream low-flow augmentation for water quality. Since the project became fully operational in December 1952, downstream water quality objectives have been achieved by flow and water temperature regulation of the Clarion River at Johnsonburg, PA, primarily to mitigate extreme Biological Oxygen Demand (BOD), caused primarily by paper mill effluents in the Clarion River.

4.6.1 Mine Drainage Abatement Measures

Both basin geology and acid pollution influence lake water quality. Because the basin is sandstone, the buffering capacity of the lake and adjoining tributaries is low and compounded by drainage from bituminous coal mines, primarily surface mining and acid precipitation. Historically, the lake was severely degraded by acid mine drainage (AMD), primarily from surface coal mining carried out between 1948 and 1960 in the western portion of the basin. Because of the severity of the acid conditions and related biological sterility of the impoundment, the lake was once locally referred to as the “Dead Sea of Elk County”⁴. In 1969, a lime neutralization plant was installed on Swamp Creek. Since this single tributary continues to contribute approximately 80 percent of the acid loading in the drainage area controlled by East Branch Dam, the treatment plant significantly reduced the acid load of the reservoir. Water quality improved so dramatically following installation, that by the early 1980’s, the lake was healthy enough to support a fishery.

Between 1996 and 2002, the Corps partnered with the Elk County Conservation District, the Elk County Fishermen, the PA DCNR and others on an in-stream limestone sand application program, in order to increase alkalinity of the East Branch Lake and its tributaries, to reestablish and enhance fisheries. Throughout the application period, a total of 671 tons of limestone sand was placed in 17 tributaries of the East Branch (between 49 and 124 tons of limestone sand per year), including Smith Run. Since these applications showed substantial water quality benefits, more permanent solutions were pursued. Passive mine drainage treatment systems were recently constructed on Johnson Run, Twomile Run, and Gum Boot Run, and in 2002 the active lime treatment plant on Swamp Creek was upgraded. For more information see:

(<http://www.dep.state.pa.us/dep/DEPUTATE/minres/Districts/homepage/Knox/Watershed/East%20Branch/East%20Branch%20Report%202002.htm>)

Smith Run makes up about 12 percent of the drainage area controlled by the East Branch Dam, and is one of the last of seven major mine drainage degraded tributaries of the East Branch identified by the PADEP in 1969 that has not yet been permanently reclaimed.

It should be noted that although there has been a continuing trend towards improving lake water quality since the early 1980’s, AMD continues to be the primary water quality problem, and alkalinity concentrations, stream buffering capacity, and biological productivity are still depressed. Because of the lack of stream buffering, and the continuing presence of AMD in the watershed upstream of the dam, the potential remains for a fish-kill, should the Swamp Creek AMD facility fail to function properly.

As a consequence of the original operational schedule (downstream low-flow augmentation), the buffering benefits of the lake, and AMD mitigation efforts in the watershed, a portion of the Clarion River now supports a coldwater, trophy brown trout fishery, and the lake supports a unique three-tiered fishery with surface warm water, mid-depth cool water, and deep cold water components.

As one progresses downstream from East Branch Dam, the dam's influence upon Clarion River water quality diminishes. The AMD dilution that the dam provides in the upper reaches of the Clarion River is not as effective below Piney Dam, due to uncontrolled tributary inflow. The

⁴Pittsburgh District Corps of Engineers, Water Supply Potential of East Branch Clarion River Lake, 1984.

Western Pennsylvania Conservancy notes on their website that despite the Clarion River's remarkable recovery from decades of pollution, its water quality is not completely restored. Below Piney Dam, mine drainage enters the river from impaired tributaries such as Piney, Deer, and Licking creeks, and ultimately flows into the Allegheny River. Treating these discharges is crucial to improving regional water quality.

4.7 NPDES Permits

In 2008, PADEP agreed to help the District determine the potential effects that alternative interim operating pools could have on National Pollutant Discharge Elimination System (NPDES) permit holders that are located downstream of East Branch Dam along the East Branch Clarion and Clarion Rivers. NPDES permits are Federal permits issued under the authority of the Clean Water Act by the Commonwealth that specify the acceptable quality of wastewater discharges to surface waters via effluent limits and contain other legally binding conditions. The Federal Government has delegated its authority to the Commonwealth to issue said permits. The most common types of wastewater discharges covered by these permits are from sewage treatment plants and industry.

According to information supplied by PADEP there are five NPDES permit holders downstream of East Branch Dam. These are noted below:

NPDES Permit Holders

Domtar Paper Mill – Industrial Waste Treatment Plant Discharge
Johnsonburg Borough – Sewage Treatment Plant Discharge
Ridgway Borough – Sewage Treatment Plant
PA American Water Company – Industrial Waste Treatment Plant Discharge
Clarion Borough – Sewage Treatment Plant Discharge

In order for the above facilities to meet the stated effluent criteria of their NPDES permits, they need to have a certain minimum flow in the Clarion River to dilute discharges to acceptable levels. **Table 4** below shows what minimum flow is needed at Johnsonburg for each of the above permit holders.

Table 4 – Flow Requirements for Holders of NPDES Permits

Permit Holder/ River Mile	Minimum River Flows At Johnsonburg Required to Meet NPDES Permit Requirements*
Domtar Paper Mill/ RM 101	80 cfs
Johnsonburg Borough/ RM 100	30 cfs
Ridgway Borough/ RM 92	30 cfs
PA American Water Company/ RM33	20 cfs
Clarion Borough (Outfall is within slackwater of Piney Reservoir/ RM 32)	0 cfs - As long as the Piney Dam Reservoir Exists

*These minimum flows were estimated by PADEP. As one progresses downstream, the drainage basin for the Clarion River increases in size which would tend to increase tributary inflows and thus provide added dilution potential.

4.8 East Branch Lake Aquatic Life Resources⁵

As mentioned above, East Branch Lake is a deep, steep sided, cold, well oxygenated, oligotrophic reservoir. The lake is over 100 feet deep near the dam and bottom water temperatures remain in the low 40's even in late summer. Due to the presence of cold, clear deep water, the Pennsylvania Fish and Boat Commission (PAF&BC) stocks the lake with lake trout fingerlings on an annual basis. Lake trout have been stocked since the 1970's. Although there is no current evidence that lake trout reproduce, they survive over warm weather months due to well oxygenated conditions in the deep colder portions of the lake.

In addition to lake trout, the PAF&BC regularly stocks the lake with brook trout fingerlings. Routine brown trout stocking was formerly practiced but discontinued by the PAF&BC in 2001. Rainbow smelt (a cold water species) were stocked in the lake in 1976 and 1977, and in tributary streams in 1979 and 1980. The stockings produced a small self-sustaining population that persisted for a while, but gradually declined. Rainbow smelt have not been captured in sampling programs since 1990.

East Branch Lake also supports a cool water fishery component and is stocked annually by the PAF&BC with walleye fry and tiger muskellunge fingerlings. Smallmouth bass are found in the lake and are self sustaining. Their growth rates are slow, however, most likely due to a low forage base, which is caused by a limited littoral zone around the reservoir and its inherent infertility.

According to the PAF&BC, rock bass, which were first captured in 1977, have become the most numerous fish species in the reservoir. In addition to rock bass, yellow perch, brown bullheads, and white suckers are found in the reservoir. Pumpkinseed sunfish are also present, but in limited numbers, due to limited shallow water and low fertility.

⁵ PA Fish and Boat Commission, communication, 2008.

Table 5 below summarizes numerically and by biomass night electro-fishing data from East Branch Lake, compiled between 1992 and 2003. The three largest numbers of fish taken during this sampling period were yellow perch (32.25%) followed by smallmouth bass (26.05%), and rock bass (17.68%). Interestingly, species by percent total weight basis (biomass) showed that smallmouth bass were 53.2 % of the total weight of fish followed by white sucker at 13.05% and rock bass at 6.49%. Although the total number of yellow perch was the highest, they only represented 5.34% of the total catch by weight. Even though the smallmouth bass represented the largest percent of the catch by weight, they were small in size, averaging approximately 3.4 ounces. In contrast, the average weight of white suckers was nearly one pound (15.3 ounces), but only 43 were taken. The sizes of other game fish were also small, averaging between 3 and 4 ounces, which may indicate a reduced forage base for top predators.

Table 5 – Night Electro-Fishing Fish Data Summary, East Branch Lake, Oct 1992 - Oct 2003, Combined					
NUMERICALLY			BIOMASS		
SPECIES	NUMBER	PERCENT BY NUMBER	SPECIES	TOTAL WEIGHT (grams)	PERCENT OF TOTAL WEIGHT
Yellow perch	983	32.25%	Smallmouth bass	76,343	53.20%
Smallmouth bass	794	26.05%	White sucker	18,733	13.05%
Rock bass	539	17.68%	Rock bass	9,307	6.49%
Pumpkinseed	336	11.02%	Pumpkinseed	8,513	5.93%
Walleye	131	4.30%	Brown bullhead	8,111	5.65%
Brown bullhead	77	2.53%	Yellow perch	7,661	5.34%
Johnny darter	57	1.87%	Walleye	6,744	4.70%
White sucker	43	1.41%	Muskellunge	3,926	2.74%
Muskellunge	40	1.31%	Northern pike	1,676	1.17%
Brook trout	16	0.52%	Lake trout	1,304	0.91%
Golden shiner	10	0.33%	Brook trout	878	0.61%
Lake trout	9	0.30%	Bluegill	187	0.13%
Northern pike	7	0.23%	Johnny darter	57	0.04%
Sculpin	2	0.07%	Golden shiner	36	0.03%
Bluegill	1	0.03%	Sculpin	10	0.01%
White crappie	1	0.03%	White crappie	5	0.00%
Blacknose dace	1	0.03%	Blacknose dace	3	0.00%
Fantail darter	1	0.03%	Fantail darter	1	0.00%
TOTAL	3,048			143,495	

4.9 East Branch Clarion River/Clarion River Aquatic Life Resources ⁶

The East Branch Clarion River that extends from East Branch Dam down to its confluence with the West Branch Clarion River at Johnsonburg is classified as a high quality, cold water fishery. Cold water supplied by outflows from East Branch Lake allows trout to survive year-round in this river reach. The Pennsylvania Fish and Boat Commission stock this reach with trout from its hatcheries. This reach also supports a limited wild, reproducing population of brook trout.

The Clarion River from its headwaters at Johnsonburg at the confluence of the East Branch Clarion and West Branch Clarion Rivers is approximately 101 miles long. The Pennsylvania Fish and Boat Commission surveyed the river in 1982 and again in 2003. In 2003, the Commission surveyed the river between the confluence of Toby Creek near river mile 84 downstream to the beginning of backwater from the Piney Reservoir near the mouth of Mill Creek at river mile 37. The Commission noted that the water quality of the Clarion River, which was historically degraded by acid mine drainage and industrial pollution, has improved greatly in the 20-year interval between surveys. The Commission reported that the improvements to the Clarion stem from acid mine drainage abatement programs, especially from the Little Toby Creek watershed that enters the Clarion River near river mile 84 (about 8 miles downstream of Ridgway) and improvements in industrial discharges from the Johnsonburg paper mill and industries located in St. Mary's that discharge into Elk Creek. Elk Creek empties into the Clarion River at Ridgway.

The Clarion River fishery has responded to the water quality improvements and now supports a diverse community of fishes, but due to infertility it is still somewhat limited in productivity. The Commission regularly stocks the Clarion River with brown trout and walleye fingerlings with the hope of establishing a self sustaining walleye fishery. The reach of the Clarion from Johnsonburg to Ridgway, a distance of about 8.6 miles, is classified as a trophy brown trout fishery and regulated by the Commission as "all tackle catch-and-release". This section of the river is popular with trout fishing enthusiasts.

The sampled section of the Clarion River between Little Toby Creek and the Piney Reservoir headwaters supports excellent self-sustaining smallmouth bass and pan fish populations. In addition, the coldwater releases and flow augmentation from East Branch Dam allow stocked fingerling brown trout to survive and mature into large size adults. The trophy brown trout reach of the Clarion River between Johnsonburg and Ridgway was upstream of the Fish Commission's 2003 survey reach.

In 2006, PADEP recommended changing the 37.4 miles of the lower Clarion River from the upstream limits of Piney Reservoir downstream to the mouth at the Allegheny River from a cold-water to warm-water stream. The recommendation was based upon the physical characteristics of the water body, dominance of warm water fish species, and the management and stocking of warm water fish by the PA F&BC.

Fish found within the Clarion River include, but are not limited to the following species: brown trout, walleye, brook trout (probably migrated from stocked tributaries), smallmouth bass, rock bass, bluegill, brown bullhead, common carp, golden redhorse, black redhorse, northern hog

⁶ PA Fish and Boat Commission, communication, 2008.

sucker, white sucker, yellow bullhead, logperch, river chub, silver shiner, striped shiner, variegated darter, banded darter and greenside darter.

4.10 Endangered Species

By letter dated 04 June 2008, the District, in response to the Section 7 of the Endangered Species Act requested information from the State College Office of the U.S. Fish and Wildlife Service on the presence of threatened or endangered species or their habitat within East Branch Lake and the East Branch Clarion and Clarion Rivers downstream of East Branch Dam. They responded with a letter dated 19 September 2008, indicating that except for occasional transient species, no federally-listed or proposed threatened or endangered species under the jurisdiction of the USFWS were known to occur within the project impact area. A copy of this letter is contained in **Appendix B**.

The District also contacted the Pennsylvania Fish and Boat Commission, Pennsylvania Game Commission, and Pennsylvania Department of Conservation and Natural Resources to determine the presence of state-listed fish, reptiles, amphibians, birds, mammals, invertebrates and plants that may be present in the project area. By letter dated 27 October 2008, the Fish and Boat Commission indicated that four state-listed rare or protected species were in the general project area: the mountain brook lamprey, gilt darter, river redhorse* and timber rattlesnake. The gilt darter and mountain brook lamprey occurred in the Clarion River. The river redhorse inhabits the portion of the Clarion River near its mouth at the Allegheny River. The timber rattler can be found on south-facing bluffs overlooking the Clarion River. A copy of the Fish and Boat Commission's letter is contained in **Appendix B**.

(***Note:** Currently, there are only three Pennsylvania (PA) listed species found in the project area: the mountain brook lamprey (*Ichthyomyzon greeleyi*; PA Threatened), the gilt darter (*Percina evides*; PA Threatened), and the timber rattlesnake (*Crotalus horridus*; PA Candidate). The river redhorse (*Moxostoma carinatum*) was delisted, late in 2008.)

4.11 Wild and Scenic River

In March 1996, a Wild and Scenic River Eligibility report was completed by the U.S. Forest Service, Allegheny National Forest, for 92 miles of the Clarion River from Ridgway to its confluence with the Allegheny River and 19 miles of Mill Creek from its headwaters to the confluence with the Clarion River upstream of Clarion. The report determined the eligibility of these streams for inclusion into the National Wild and Scenic Rivers System. The Wild and Scenic Rivers Act (Public Law 90-542), passed on October 2, 1968, protects free-flowing rivers that possess outstandingly remarkable characteristics. Eligibility is determined based upon whether the river segment(s) are free flowing and have outstandingly remarkable value (scenic, recreation, fish, and wildlife, heritage, etc.). To make this decision, the resources of the river and river corridor (¼ mile on either side) were inventoried⁷.

The Clarion River was included in the original Wild and Scenic Rivers Act but in 1969 was determined ineligible due to poor water quality from acid mine drainage, untreated domestic sewage and industrial wastes. Since 1969, as water quality improved, interest grew in re-

⁷ U.S. Forest Service, "Clarion River and Mill Creek Wild and Scenic River Eligibility Report" 1996.

examining the river to determine its eligibility to be included within the Nation’s list of Wild and Scenic Rivers. The Forest Service’s eligibility report concluded that 51.7 miles of the Clarion River, downstream from the Allegheny National Forest/State Game Land #44 boundary (just downstream of Ridgway) to the beginning of the slackwater created by Piney Dam could qualify for inclusion in the Wild and Scenic River system. The river was judged to have outstanding visual character and recreational value for canoeing, picnicking, sightseeing, camping, birding, wildlife watching, fishing and hiking. According to the Eligibility Report, the Clarion River is classified as a C1 resource. “C” meaning that it is a flat flowing river with velocities that make it desirable for canoeists of all abilities, and “1” meaning that the river has fast moving water with riffles and waves and few or no obstructions, all of which are easily avoided with little training. The risk to swimmers is slight with self-rescue judged as being easy.

As a result of the re-evaluation process, on June 4, 1996, Congressman Clinger introduced a Bill, H.R. 3568, during the Second Session of the 104th Congress that designated 51.7 miles of the Clarion River as a component of the National Wild and Scenic River System. This bill, which was approved, named specific river reaches as either scenic or recreational. The river reaches are identified in **Table 6** below:

Table 6 – Clarion River Wild and Scenic River Reaches

River Reach Description	Classification
8.6 Mile Reach - Allegheny National Forest /State Game Lands #44 boundary to Portland Mills	Recreational River
8 Mile Reach - Portland Mills to Allegheny National Forest boundary, located 0.8 miles downstream of Irwin Run	Scenic River
26 Mile Reach - 0.8 miles downstream of Irwin Run to State Game Lands 283 boundary, located 0.9 miles downstream of Cooksburg bridge	Recreational River
9.1 Mile Reach 0.9 miles downstream of Cooksburg bridge downstream to the Piney Run Dam backwater, located 0.6 miles downstream of Blyson Run	Scenic River

4.12 Noise/Aesthetics

The East Branch Lake, East Branch Clarion River, and Clarion River corridor is primarily forested and one of the least developed areas in Pennsylvania. The undisturbed tracts of forest land along the river corridor provide outstanding aesthetic quality and contributed heavily to the determination that 51 miles of the Clarion River between Ridgway and the Piney Dam headwaters were included in the Wild and Scenic River system.

The lake area can be noisy, especially during warm and sunny summer days, due to the operation of power boats. There is no horsepower limit within the lake. Summer weekends at the lake are usually noisier than during the week due to heavier usage.

The rivers downstream are too shallow for power boating and can be navigated only by canoes, kayaks, rafts, and other shallow water craft. Given the remote nature of the river corridor and the types of recreation supported by the East Branch and Clarion rivers, the corridor is usually quiet.

4.13 Recreation Resources

4.13.1 East Branch Lake Recreation

East Branch Lake is one of the most popular sites for recreation in northwestern Pennsylvania. The area in the vicinity of the dam is maintained by the Corps. In this area, the Corps provides public camping and picnicking areas and a boat launching ramp on the right descending bank, just upstream of the dam. East Branch campground, managed by the Corps, is open from mid-April to mid-October. The remainder of the land surrounding the lake is managed by the Commonwealth as Elk State Park, Elk State Forest, and state game land. Unlimited horsepower boating is allowed on the lake and water skiing is very popular. The state operates a boat launching ramp at the upper end of the lake within Elk State Park. Fishing is also popular at the lake, which has both cold-water and cool-water components. Lake trout survive within East Branch Lake due to the cold water present at lower depths year-around and muskellunge, walleye and smallmouth bass (cool water species) are also present and sought after by anglers. Ice fishing is also permitted during the winter after the lake freezes over. Hunting within the state game lands around the reservoir is popular, and deer, turkey and bear are regularly taken. Hunting is not permitted on Corps-managed land near the dam or within camping areas. **Table 7** below presents an estimated breakdown of the type of recreation activities occurring at East Branch Dam. The data was based upon visitor data taken from 1998 to 2007. As can be seen in the table, for this period, the three top activities were boating (36%), fishing (24%) and sightseeing (16%). Water-dependent activities (i.e., boating, fishing, swimming, and water skiing), however, made up 70% of all recreational usage.

Table 7 – Recreational Activities, East Branch Lake, Percent Usage, 1998-2007

Activities	Percentage
Boating	36.10%
Camping	0.60%
Fishing	24.26%
Hunting	0.10%
Picnicking	9.89%
Sightseeing	16.29%
Swimming	0.04%
Water Skiing	10.26%
Winter	0.00%
Other	2.46%
Total	100.00%

Average recreation days at the project are shown in **Table 8** below. These values represent all the types of recreational activities shown in **Table 7** above. As noted in this table, the largest and most expected number of recreation days occurs during the warmer recreation season, June through September.

Table 8 – Average Annual Recreation Days, East Branch Lake, 2002-2010*

Month	Average Recreation Days
Oct	7,696
Nov	5,963
Dec	4,321
Jan	4,873
Feb	4,535
Mar	5,508
Apr	13,268
May	17,268
Jun	40,299
Jul	50,756
Aug	39,590
Sep	27,127
Total	221,565

* Updated 31 March 2010.

4.13.2 Clarion River Recreation

As mentioned previously in this assessment, 51 miles of the Clarion River between Ridgway and the beginning of slackwater created by Piney Dam has been included in our Nation's Wild and Scenic River system. Because of its superior scenic and recreational qualities, the area is immensely popular. It is an extremely popular natural resource for tubing, canoeing, kayaking, and rafting. During the later summer, the river does get shallow and portage is required in places. Several canoe liveries operate along the Clarion River. Fishing on the Clarion River, especially between Johnsonburg and Ridgway, is very popular. This 8-mile reach of river is recognized as a trophy brown trout fishery that attracts fisherman from afar.

4.14 Socio-Economic Conditions

Based upon the year 2000 census, the population of communities directly adjacent to the Clarion River was 33,699. Annually, from 1990 to 2000, the population of these same communities, on average, decreased by 0.1 percent resulting in a reduction of 332 persons (the population was 34,031 in 1990). Minorities in the Clarion River Valley consist of very small portions of the population; only 2.1 percent (699 persons) of the total population of this area were classified as minority.

The percentage of adults older than 25 years of age with no high school diploma in the Clarion River Valley was 16.2 percent (3,413 persons). In contrast, the percentage of adults older than

25 years of age with at least a bachelor's degree in the overall Clarion River Valley was 15.7 percent (3,305 persons); this lower than the number of persons without a high school diploma.

Average median household income for the Clarion River Valley in 2000 was \$32,510. Average per capita income for 2000 was \$17,177 in the Clarion River Valley communities. The unemployment rate at the time of the 2000 census in the Clarion River Valley was 6.9 percent (1,120 persons). The Clarion River Valley combined, had a poverty level of 15.0 percent (4,701 persons).

The average vacant housing rate for the Clarion River Valley was 29.9 percent (5,610 housing units). Of the occupied housing units, the average percentage of those units that were renter-occupied for the Clarion River Valley was 27.9 percent (3,661 renter-occupied housing units). The average median house value in the Clarion River Valley was \$67,677. The number of households expending at least 30 percent of their annual income towards housing costs in the Clarion River Valley was 14.8 percent (1,025 owner-occupied housing units).

4.15 Air Quality

According to the Environmental Protection Agency's (EPA) website (<http://www.epa.gov/air/urbanair/6poll.html>), the Clean Air Act requires EPA to set National Ambient Air Quality Standards for six common air pollutants. These commonly found air pollutants (also known as "criteria pollutants") are found all over the United States. They are particle pollution (often referred to as particulate matter), ground-level ozone, carbon monoxide, sulfur oxides, nitrogen oxides, and lead. These pollutants can harm your health and the environment, and cause property damage. Of the six pollutants, particle pollution and ground-level ozone are the most widespread health threats. EPA calls these pollutants "criteria" air pollutants because it regulates them by developing human health-based and/or environmentally-based criteria (science-based guidelines) for setting permissible levels.

In April 1999, EPA issued a Clean Air Act violation notice to Willamette Industries, Inc., the former owner of the Domtar paper mill in Johnsonburg. Prior to Domtar's acquisition of the plant, Weyerhaeuser acquired it in June 2002 after the company's merger with Willamette. EPA and the Commonwealth of Pennsylvania alleged that Weyerhaeuser modified and operated two coal-fired power boilers without required upgrades to air pollution control equipment. The complaints also alleged that Weyerhaeuser failed to obtain required state-issued permits limiting sulfur dioxide emissions, and violated Clean Air Act standards applicable to fossil-fuel-fired steam generating units. In October 2003, as a consequence of EPA's consent decree, Weyerhaeuser completed installation of state-of-the-art sulfur dioxide (SO₂) scrubbers on the plant's power boilers, at a cost of about \$5.5 million. The consent decree required Weyerhaeuser to operate these scrubbers in accordance with standards designed to reduce SO₂ air emissions by up to 95 percent.

Based upon a review of the Pennsylvania Bureau of Air Quality and EPA's web sites, in March 2009, the air quality of Elk, Jefferson and Clarion Counties is good and does not exceed any of the criteria for the six common air pollutants, including SO₂.

4.16 Cultural Resources

Two investigations were conducted at East Branch Lake to determine the presence of historic and archaeological resources. The first survey was part of the Interagency Archaeological Program, performed by the Smithsonian Institute in cooperation with the National Park Service and the Corps, in 1950. Ralph S. Solecki of the River Basin Surveys branch of the Smithsonian conducted the survey, with the assistance of William Mayer-Oakes of the Pittsburgh Carnegie Museum. This survey found no cultural resources in the project area. The second survey was conducted by Archaeological Service Consultants, Inc., of Columbus, Ohio, in 1989. This second survey, lead by Dr. Flora Church, confirmed the results of the first, that no archaeological properties are present on federal lands at East Branch Dam. The District consulted with the Pennsylvania Bureau for Historic Preservation (PABHP) in this final determination.

The District is currently conducting a National Register of Historic Places eligibility evaluation of all of our reservoir dams, including East Branch Dam. This evaluation study will focus on each dam's individual eligibility as well as part of the group of all District reservoir dams under a theme of response to federal programs for flood control, water quality, and recreation. It is the District's opinion that East Branch Dam and its supporting structures are potential eligible for listing under Criterion A based on the association of this facility with important events in broad patterns of our history. This study will be coordinated with the PABHP and we shall consult with them under Section 106 of the National Historic Preservation Act on any proposed action involving permanent repairs that will potentially have adverse effects upon this historic property.

4.17 HTRW

Current and historical oil wells are known to be located both upstream and downstream of the East Branch Dam. In addition to these known wells, a historical well was thought to have been encountered during geotechnical drilling and testing at a location on the downstream embankment slope of the dam on 12 May 2009. Results of sampling and analyses of the free product from this well indicated the mixture was contaminated, but non-hazardous. No other subsurface investigations for HTRW were conducted at the time.

Phase I preliminary site assessments have been conducted and Phase II site investigations will be conducted (given the encounter described above) during the early stages of the Preconstruction-Engineering-Design Phase of work.

At the completion of the Phase I and Phase II investigations, HTRW concerns (i.e., location and mitigation of impacts, associated costs, environmental constraints that would render an alternative infeasible) can be fully addressed. The only potential environmental concerns known of at this time are the historic abandoned oil wells.

5.0 Environmental Consequences

This section of the EA analyzes the impacts of the final dam repair alternatives described in Sec. 3.12 (S3, S4, S5, S6), including the “No Action” alternative (NS1).

5.1 Consequences Common to All Alternatives

Because the following environmental parameters are not affected by any of the alternatives, they are listed below once to avoid redundancy.

5.1.1 Environmental Justice

Minority and low income populations within the communities downstream of East Branch Dam consist of less than 2.1% of the population. Given these populations are spread throughout these communities, they cannot be disproportionately affected by any construction activity. As such, no environmental justice impacts can be attributed to the “No Action” alternative or any of the remaining alternatives described in this EA.

5.1.2 Cultural Resources

The District is in the process of determining the eligibility of the dam and its associated structures for the National Register. Until that evaluation is complete, the District is taking the position that the dam is eligible and it will therefore be treated as if it were on the Register. Regardless of which repair alternative is selected to make long-term repairs to the dam structure, the District will evaluate the effect those repairs have on the dam’s eligibility. This evaluation will be done in consultation with the PABHP. If potential adverse effects are identified, a mitigation plan will be developed under Section 106 of the National Historic Preservation Act.

5.1.3 Noise

Local residents near East Branch Dam, campers using nearby project grounds, and boaters either at considerable straight-line distances across the lake or near immediate downstream areas, may be disturbed by construction-associated noise. All of the alternatives involving construction would cause noise generated by drilling rigs, trucks, and other heavy equipment. Given the purpose of this work (i.e., to increase dam safety) contractors could work multiple shifts per day, six or more days a week, an estimated eight months of the year. (Work plans are not developed at this point.) Noise generated by such work, however, is a temporary condition that will cease upon completion. Nothing can be done about noise generation except to require construction contractors ensure all engine mufflers on trucks and heavy equipment are in good working order.

Nearby residents may accept a certain amount of construction noise given dam repairs coincide with their long-term interests as landowners. Also, most campgrounds around East Branch Dam have landforms between them and the dam. Additionally, boaters are able to move away from dam activity, thereby reducing noise to acceptable levels. (**Note:** The possibility exists that boaters may not notice or be bothered by construction noise, given the amount of noise that motorized watercraft create at East Branch Lake; see Sec. 4.12. There are not any horsepower limits on power boats at East Branch Lake, and it has been observed that the lake area can be noisy, especially during warm and sunny days, and usually more on summer weekends than weekdays.) In certain cases, different species of wildlife have been shown to be affected by noise, such as by snowmobiles; however, almost all species are mobile enough to relocate away from local fixed sources, such as the dam construction site.

5.2 Consequences of “No Action” Alternative NS1 – IRRMs Made Permanent

The “No Action” alternative, plan NS1, would indefinitely extend, essentially make permanent, all Interim Risk Reduction Measures (IRRM) at East Branch Dam with target pool elevations of 1650 for summer and 1623 for winter (see Sections 2.5 and 3.1). As noted previously in this EA, because emergency action was taken to modify the water control plan in early 2008, “No Action” cannot literally mean “doing nothing.” The impacts of “No Action” were previously analyzed in the EA prepared the spring of 2009 by the District for alternative interim operating pools (see Appendix A). The information below summarizes that EA.

5.2.1 Public Safety Impacts

Current IRRMs were developed to allow risk-improved operating conditions for an interim period until a long-range strategy is developed and implemented, while avoiding significant impacts to public safety downstream. The dam’s flood control capabilities, however, are reduced, and current IRRMs were not conceived or developed to be maintained indefinitely. The District is and will continue to closely monitor the areas of concern at the dam and will immediately take action upon evidence of any initiating events. IRRMs currently in place will be reviewed annually, until a long-term risk reduction measure is in place.

5.2.2 Water Quality Impacts

Water quality would not suffer from implementation of the “No Action” alternative, especially with use of the new control tower chute. Under the interim operating schedule, there will be no changes made to the originally authorized downstream release schedule, unless there is no reservoir storage available, due to severely extended drought. The pool will simply be operated at a lower level. Continuation of the release schedule is considered a high priority in order to provide necessary flows to all downstream users, protecting water quality. This alternative does not include any geologically intrusive activities and therefore would not affect any historic oil wells, eliminating any chance of release of petroleum contaminants.

5.2.3 Lake and Downstream Fishery Impacts

None of the cold-water fisheries would suffer from the implementation of the “No Action” alternative, given use of the new control tower chute, unless the District were to experience severe drought. *Regarding the cold-water lake fishery:* if the pool were reduced from 1,200 acres (normal) to 500 acres, the lake would not maintain the present lake trout fishery because temperatures in the normally colder hypolimnion (bottom-most volume) would exceed 60° F, the maximum survival temperature for lake trout. Previous studies have shown that 100 percent of the lake would exceed 60°F in September and October (see Appendix A, Section 6.2). *Regarding the cold-water downstream fishery:* a lack of low-flow augmentation, resulting from a greatly reduced pool, potentially resulting from a severe prolonged drought would result in the loss of the sustainable cold water fishery in the East Branch Clarion and Clarion Rivers, downstream of the dam. Moreover, accumulated sediment on the exposed lake bottom could erode during rain events, become suspended in the remaining lake, and discharge downstream. This re-suspended sediment could cause severe impacts to aquatic organisms and habitat downstream; clogging gills, smothering eggs, and filling interstices among the gravels and cobbles that make up very important river bottom habitat for benthic macroinvertebrates and fish. Warm-water fisheries are not as temperature limited as cold-water fisheries; however,

untreated acid mine drainage (AMD) entering the lake is being diluted by pool volume. With loss of pool, AMD dilution would be eliminated, which could severely affect the both the warm-water and cold-water river fisheries above and below East Branch Dam.

Under the interim operating schedule, there will be no changes made to the originally authorized downstream release schedule, unless there is no reservoir storage available, due to drought. The pool will simply be operated at a lower level. Continuation of the release schedule is considered a high priority in order to provide necessary flows to all downstream fish and other aquatic life.

5.2.4 Impacts to NPDES Permit Holders

Under average conditions, none of the current NPDES permit holders would be in violation of their discharge requirements. During drought conditions, however, all of the NPDES permit holders, except for the Clarion Borough Sewage Treatment Plant, could violate their permits between mid-September, and all or parts of November. With a total loss of pool, the Johnsonburg Sewage Treatment Plant, Ridgway STP, and PA American Water Plant could exceed their discharge criteria between early June and the latter part of November, and the Domtar Mill could be in violation for up to 200 days between late May and early December.

Under the interim operating schedule there will be no changes made to the originally authorized downstream release schedule, unless there is no reservoir storage available, due to drought. The pool will simply be operated at a lower level. Continuation of the originally authorized downstream release schedule is considered a high priority in order to provide necessary flows to all water users, including the paper mill at Johnsonburg, the City of Ridgway, and a peaking hydroelectric plant near Clarion.

5.2.5 Socio-Economic and Recreation Impacts

Annual benefits related to recreation would be slightly reduced if permanent IRRMs were adopted, but would be susceptible, along with commercial and industrial benefits, to further reduction during drought. For example, under a severe prolonged drought (a worst-case scenario), a smaller 500-acre lake might remain behind the dam, providing only minimal low-flow augmentation capabilities. Additionally, such a pool's value for recreation would be limited due to difficult access without useable boat launch ramps, year-around. (Only lightweight carry-in recreational craft such as canoes and kayaks would likely be used within such a residual lake.) Nonetheless, under average conditions (i.e., if IRRMs made permanent; resulting in a 1650 normal summer pool), the annual recreation and economic impacts would only amount to about a 1 percent loss of benefits, about a \$1 million loss. During drought conditions, the loss of annual recreation and economic benefits compared to baseline conditions (i.e., the originally authorized 1670 pool) would be somewhat worse, totaling about an 8 percent loss of benefits, about an \$8 million loss. For more detail, see Appendix A, Section 6.2.5.

Under the interim operating schedule there will be no changes made to the originally authorized downstream release schedule, unless there is no reservoir storage available, due to drought. The pool will simply be operated at a lower level. Continuation of the current release schedule is considered a high priority in order to provide necessary flows to all downstream water users, including a paper mill at Johnsonburg, the City of Ridgway, a peaking hydroelectric plant near Clarion, and all those using the river for recreational activities.

5.2.6 Wild and Scenic River Impacts

The Clarion River's Wild and Scenic River status would not suffer from the implementation of the "No Action" alternative, unless the District were to experience a drought, in which case, low-flow augmentation could be severely affected. Without the diluting effects of low-flow augmentation, the relative concentrations of both AMD, and industrial and sewage treatment plant discharges would increase. The resultant water quality degradation combined with reduced river flow/levels during the recreation season could result in re-evaluation and potential loss of the river's Wild and Scenic status.

5.2.7 Wetland Impacts

Wetlands associated with East Branch Lake (above the dam) would not suffer from the implementation of the "No Action" alternative, unless the District were to experience a drought, in which case, current wetlands would likely be lost and new wetlands re-established at a lower elevation within the reservoir. Downstream wetland impacts (below the dam) could be severe due to loss of low-flow augmentation during the latter half of the growing season. Downstream wetlands affected by the lack of flow would be lost temporarily, but would likely re-establish during the next growing season, but their quality would become degraded, due to late growing season desiccation.

5.2.8 Endangered Species Impacts

No Federally-listed threatened or endangered species or their habitats are known to occur in the project area. There are three Pennsylvania (PA) listed species found in the project area: the mountain brook lamprey (*Ichthyomyzon greeleyi*; PA Threatened), the gilt darter (*Percina evides*; PA Threatened), and the timber rattlesnake (*Crotalus horridus*; PA Candidate). According to the Pennsylvania Fish Commission, the two aquatic species are found in the lower Clarion River. Consequently, they could be adversely affected by increased turbidity, associated with the erosion of exposed lake-bottom sediment, potentially brought about by a drought and the resultant lower pool elevations. The timber rattlesnake would not be affected by the "No Action" alternative.

5.3 PREFERRED PLAN: Alternative S3 - Full-depth Cut-off Wall, Full-length, with Grouting and Secant Shafts

5.3.1 Public Safety Impacts

Studies indicate that construction of the cutoff wall near the centerline of the dam, as described for Plan S3 (see Sec. 3.6), would both reduce the risk of dam failure to well within tolerable risk guidelines, and allow the dam to be permanently returned to normal operations under its originally authorized water control plan. IRRMs would be maintained until construction is complete and instrumentation indicates acceptable seepage conditions exist in the dam and foundation.

5.3.2 Water Quality Impacts

Plan S3 should not affect water quality; the control tower modification with the added chute (see Sections 2.3.3 - 2.3.5) provides the District the flexibility to maintain optimum lake and downstream water temperatures. This plan, however, has the potential to intersect other historic oil wells, increasing the chance of release of petroleum contaminants. Geotechnical surveys are planned to prevent such an occurrence. IRRMs would be maintained until

construction is complete and instrumentation indicates acceptable seepage conditions exist in the dam and foundation.

5.3.3 Lake and Downstream Fishery Impact

Plan S3 would not adversely affect the lake or downstream fisheries. Due to the control tower modification made in 2008, the District has the flexibility to control water temperatures both within the lake and downstream. This helps the District avoid impacts to the cold and cool water components of the lake fishery, and the cold water trout fishery downstream of the dam. IRRMs would be maintained until construction is complete and instrumentation indicates acceptable seepage conditions exist in the dam and foundation.

5.3.4 Impacts to NPDES Permit Holders

Plan S3 would not adversely affect current NPDES permit holders. This plan's completion will allow the dam to be permanently returned to normal operations under its originally authorized water control plan. IRRMs would be maintained until construction is complete and instrumentation indicates acceptable seepage conditions exist in the dam and foundation.

5.3.5 Socio-Economic and Recreation Impacts

The economic and recreation impacts of Plan S3 would be identical to those already described in Appendix A, Section 6.10. This alternative would maintain IRRM pools and associated measures until dam repairs are complete and instrumentation indicates acceptable seepage conditions exist in the dam and foundation; until that time, anticipated annual benefits related to recreation and economics would be slightly reduced, as described above in Section 5.2.5. Economic and recreational impacts caused by the temporarily lowered pool are not considered significant over the period of construction. Depending upon logistics, however, the boat launching ramp near the dam may be closed for certain periods during construction. Should this occur, all boat-dependent recreation, such as water skiing or fishing would be temporarily stopped. Similar economic and recreational impacts will occur when the upper launching ramp in Elk State Park becomes inaccessible due to a lowered pool (this ramp goes out of service at El.1640). It is estimated that with average rainfall conditions under IRRM pools, Elk State Park boat ramp will only be available from early April through the end of July, approximately four months, but under dry conditions, would go out of service sooner.

5.3.6 Wild and Scenic River Impacts

Plan S3 would not adversely affect the Wild and Scenic River status of the Clarion River, since low-flow augmentation would be maintained during construction.

5.3.7 Wetland Impacts

It has been determined that the lower IRRM pools increased wetland acreage around the reservoir by exposing more shallow sloped areas. These wetlands will be maintained during construction of Plan S3. After construction, when the pool is returned to its originally authorized operating levels, these created wetlands will be flooded and lost. The wetlands that existed prior to the temporary pool lowering would re-establish, as they existed at the normal 1670 operating level.

5.3.8 Endangered Species Impacts

No Federally-listed threatened or endangered species or their habitats are known to occur in the project area. State-listed species found in the lower Clarion River (there are two aquatic species, addressed in Sec. 5.2.8) should not be adversely affected by increased turbidity, given the planned maintenance of newly created wetlands around the IRRM pools for Plan S3 (see Sec. 5.3.7). The timber rattlesnake would not be affected by this alternative.

5.4 Consequences of Alternatives S4 and S5 – Dam Extension & Fortification, and Downstream Gravity Structure

These two plans have been combined, given their similar intent and the similarity of their environmental consequences.

5.4.1 Public Safety Impacts

Under these alternatives, the current water control plan for the 1650 interim would be maintained until the dam extension/gravity structure is completed. There would be no loss of flood control benefits during construction, and the lake would continue to operate safely until repairs are completed and, for Plan S4, until instrumentation indicates acceptable seepage conditions exist in the dam and foundation.

5.4.2 Water Quality Impacts

The water quality impacts for these alternatives would be similar to those previously discussed for Plan S3 in Sec. 5.3.2, and in Appendix A, Sections 6.5 and 6.6; only potentially affected by historic oil wells. The operation of the reservoir under the interim 1650 water control plan would continue to provide high quality water to meet the demands of downstream users, until restored to its original 1670 operating level. During construction of the dam extension or gravity structure, and outlet tunnel extension, good engineering practices, and specific erosion and sedimentation controls would be implemented to minimize release of downstream turbidity. These alternatives, however, do include the potential to impact up to seven or more historic oil wells, increasing the chance of release of petroleum contaminants. Appropriate geotechnical surveys would be necessary to prevent such an occurrence. IRRMs would be maintained until construction is complete and instrumentation indicates acceptable seepage conditions exist in the dam and foundation.

5.4.3 Lake and Downstream Fishery Impact

Like Plan S3, these alternatives would preserve the lake and most of the downstream fishery during construction. The 1650 interim pool and use of the new chute attached to the control tower would allow preservation of the lake's coldwater habitat component and low-flow augmentation, providing optimum temperatures during the summer and fall to maintain the downstream trout fishery. Construction of these alternatives, however, would require the downstream placement of considerable fill or concrete within the East Branch Clarion River to build the dam extension or gravity structure, and extend the outlet tunnel. This would result in the permanent loss of about 600 feet of high-quality, cold water stream habitat immediately below the lip of the current structure. Again, during construction of the dam extension/gravity structure and outlet tunnel extension, good engineering practices, and specific erosion and sedimentation controls would be implemented to minimize release of downstream turbidity. IRRMs would be maintained until construction is complete and instrumentation indicates acceptable seepage conditions exist in the dam and foundation.

5.4.4 Impacts to NPDES Permit Holders

Like Plan S3 (see Sec. 5.3.4), these alternatives would not impact current NPDES permit holders. There will be sufficient downstream low-flow augmentation throughout the year to meet the NPDES criteria demands of all the permit holders. IRRMs would be maintained until construction is complete and instrumentation indicates acceptable seepage conditions exist in the dam and foundation.

5.4.5 Socio-Economic and Recreation Impacts

The economic and recreation impacts of these alternatives would be minor and are identical to Plan S3, discussed above in Sec. 5.3.5.

5.4.6 Wild and Scenic River Impacts

These alternatives would not impact the Wild and Scenic designation of the Clarion River, as noted Plan S3 (Sec. 5.3.6), because downstream low-flow augmentation will be maintained during construction. IRRMs would be maintained until construction is complete and instrumentation indicates acceptable seepage conditions exist in the dam and foundation.

5.4.7 Wetland Impacts

The wetland impacts of these alternatives would be similar to Plan S3, discussed above in Sec. 5.3.7. IRRMs would be maintained until construction is complete and instrumentation indicates acceptable seepage conditions exist in the dam and foundation.

5.4.8 Endangered Species Impacts

The effects of these alternatives on endangered species would be similar to Plan S3, discussed above in Sections 5.2.8 and 5.3.8. IRRMs would be maintained until construction is complete and instrumentation indicates acceptable seepage conditions exist in the dam and foundation.

5.4.9 Terrestrial Impacts

These alternatives differ dramatically from the other two construction alternatives in that at least one alternative would require a temporary borrow area easement totaling about 72 acres. Good engineering practices, and specific erosion and sedimentation controls would be implemented to minimize the release of downstream turbidity; yet, such borrow areas can severely impact existing terrestrial wildlife, avian habitat, vegetation, groundwater, surface water, vernal pools, and wetlands. As such at the very least, top-soils should be stored and protected from erosion. After returning top-soil to the disturbed borrow area, soil should be tilled to reduce compaction and increase loft, before being replanted (preferably with native species) to reduce erosion and reduce impacts by exotic invasives. Short-term and long-term consideration should be given to what plant species are introduced, matching any existing management plans. Additionally, mitigation opportunities, such as wildlife structures, should be considered.

Access to and from borrow areas is also a concern. If existing public roads are used, they would have to be identified by route, the lengths traveled, their weight limits or restrictions, how many trucks per hour would be expected on them during construction, and the total number of days during which the access routes will be used and the seasons of year. Consideration would also have to be given to what type of delays or problems could occur with local traffic, such as delays at bridges. If new roads are going to be cut, their size would have to be determined, along with

the amount and type(s) of habitat that would be lost. Consideration must also be made of the removal of such roads, e.g., are they to be replanted or abandoned? If removed, how would compacted soils be loosened to encourage the re-establishment of vegetation?

5.5 Consequences of Alternative S6 - Removal of Dam

5.5.1 Public Safety Impacts

If the dam were removed, all of the project's flood control benefits would be permanently lost, subjecting downstream communities to increased risk of flooding during high water events.

5.5.2 Water Quality Impacts, Socio-Economic and Recreation Impacts, and Lake and Downstream Fishery Impacts

The removal of East Branch Dam would cause severe water quality, social, economic, and recreational impacts to the region. Water quality degradation and the lack of low-flow augmentation would negatively affect most downstream recreation; all recreation benefits provided by the lake would be permanently lost; the lake fishery would be lost; and the downstream coldwater fishery would be lost due to water quality degradation caused by lack of low-flow augmentation, AMD pollution, and uncontrolled heavy benthic sediment pulses from accumulated sediment deposits on exposed lake bottom. This alternative's activities, however, would likely not affect any historic oil wells in the area, with the appropriate controls in place.

5.5.3 Impacts to NPDES Permit Holders

Impacts of Plan S6 would include the Domtar Mill either being forced to close or to find another source of water, and the Piney Hydropower Plant would be adversely affected due to a loss of flow.

5.5.4 Wild and Scenic River Impacts

This alternative would likely result in the review of the Clarion River's Wild and Scenic River designation.

5.5.5 Wetland Impacts

The net gain or loss of wetlands is unknown. The wetlands within the lake area would be lost, but new wetlands would eventually re-establish along the East Branch Clarion River as it wends a new course along the former lake bottom. The loss of low-flow augmentation would adversely affect existing downstream wetlands, too, but some of these wetlands would re-establish themselves. All shoreline wetlands would re-establish based upon natural uncontrolled flow—the river would revert to what it was like prior to the construction of East Branch Dam.

5.5.6 Endangered Species Impacts

As noted in Sec. 5.2.8, no Federally-listed threatened or endangered species or their habitats are known to occur in the project area. There are, however, three Pennsylvania (PA) listed species found in the project area. According to the Pennsylvania Fish Commission, the two aquatic species are found in the lower Clarion River. These two species could be adversely affected by increased turbidity associated with the erosion of exposed lake-bottom sediment brought about by the dam's removal. The third listed species, the timber rattlesnake, would not be affected by removal of the dam.

5.6 Impact Summary Table

Table 9 below summarizes the impacts of all the repair alternatives considered and discussed above. This table also includes the "No Action" alternative for comparison purpose

Table 9 – East Branch Dam Summary of Repair Alternative Impacts

Environmental Parameters	“No Action” Alternative NS1 - IRRMs Made Permanent	Alternative S3 - Full-length Cutoff Wall, Centerline of Dam	Alternative S4 - Dam Extension and Fortification	Alternative S5 - Downstream Gravity Dam	Alternative S6 - Remove Dam
Public Health & Safety	Long-term dam safety cannot be assured without a permanent risk reduction measure in place. Flood control reduced.	Eliminates threat of dam failure. Restores full flood control capabilities and operational capacity.	Eliminates threat of dam failure. Restores full flood control capabilities and operational capacity.	Eliminates threat of dam failure. Restores full flood control capabilities and operational capacity.	No dam: total loss of flood control and operational capacity. Severe periodic flood risk.
Water Quality	No significant effects. New control tower chute helps maintain optimum temperatures.	Small potential effect from historic oil wells (1-2 more wells possibly within current footprint). New control tower chute helps maintain optimum temperatures.	Moderate potential effect from historic oil wells (7 or more wells suspected within construction footprint). New control tower chute helps maintain optimum temperatures.	Moderate potential effect from historic oil wells (7 or more wells suspected within construction footprint). New control tower chute helps maintain optimum temperatures.	No reservoir - severe effects: - no low-flow augmentation, - loss of AMD dilution, and - heavy sediment washout from erosion of reservoir bottom.
Lake & Downstream Fisheries	Cold-water lake and downstream fisheries will be maintained.	No effect.	Loss of up to 600 feet of river and shore habitat to place extension and extend control tower outlet.	Loss of up to 600 feet of river and shore habitat to place gravity dam and extend control tower outlet.	No lake – appreciable effects. Total loss of lake fishery and loss of downstream cold-water fishery (with no low-flow augmentation). Impacts on other downstream fish populations from undiluted AMD and heavy sediment pulses until lake-bottom washout complete.
NPDES Permit Holders	No effects under average conditions.	No effects.	No effects.	No effects.	Multiple severe impacts on reliant communities and industry.
Socio-Economics and Recreation	Slight effect with average precipitation: combined (economics & recreation) annual loss about 1 % (about \$1 million). Greater effect during drought: combined annual loss about 8% (about \$8 million).	During construction: slight effect with average precipitation (see left), greater effect if drought (see left). After construction: full benefits restored.	During construction: slight effect with average precipitation (see left), greater effect if drought (see left). After construction: full benefits restored.	During construction: slight effect with average precipitation (see left), greater effect if drought (see left). After construction: full benefits restored.	Severe socio-economic and recreational impacts, due to water quality degradation, lack of low-flow augmentation, AMD pollution, and uncontrolled heavy sediment: - all lake's recreation benefits permanently lost, - lake fishery would be lost, - downstream cold water fishery would be lost.
Wild and Scenic River Status	No effect under average conditions.	No effect.	No effect.	No effect.	Reconsideration of Wild & Scenic River designation.
Wetlands	No net effect.	No effect.	No effect.	No effect.	Net gain or loss unknown.

Environmental Parameters	“No Action” Alternative NS1 - IRRMs Made Permanent	Alternative S3 - Full-length Cutoff Wall, Centerline of Dam	Alternative S4 - Dam Extension and Fortification	Alternative S5 - Downstream Gravity Dam	Alternative S6 - Remove Dam
Endangered Species	No effect, unless severe drought.	No effect.	No effect.	No effect.	Potential impacts to 2 state-listed species from undiluted AMD and heavy sediment pulses, until lake-bottom washout complete.

5.7 Cumulative Impacts of Alternative Plans

The Council on Environmental Quality's (CEQ) regulations for implementing the National Environmental Policy Act (NEPA) define cumulative effects as, "...the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-federal) or person undertakes such other actions (40 CFR §1508.7)."

In simple terms, a cumulative effects analysis considers the impacts of a proposed action in relation to what else is occurring, has occurred, or potentially may occur in a given project area. To keep a cumulative effect analysis meaningful, bounds must be set to establish a reasonable time frame and impact area. For this project, a rough time frame for future actions would be 20 years from the present, and the impact area considered is East Branch Lake and the East Branch Clarion and Clarion Rivers downstream to the head of the Piney Fork Dam slackwater.

5.7.1 Past, Present, and Future Actions

The cumulative impacts described below would be the combined effect of the past, present, and reasonably foreseeable future actions and how they would affect the entire project area. This discussion is necessarily qualitative since future actions are based upon a mixture of professional judgment and common sense rather than on specific quantifiable variables, such as numbers of new recreational cabins to be constructed along the Wild and Scenic reach of the project area. This analysis takes a common sense approach and assumes that the dam will be repaired and that the interim pool will be maintained until all repairs are completed. Although an alternative was considered that would cause the permanent loss of the pool, the impacts that losing the pool would have on the social and economic fabric of the region, as noted in this report, would be too severe to seriously consider, much less implement.

5.7.2 Cumulative Effects of Proposed Alternatives

The description of the effect of past, present and reasonably foreseeable future actions upon the eight environmental parameters evaluated in Sec. 5.6 (see **Table 9**) are presented below in **Table 10** in a tabular summary format to facilitate ease of reading and comparison.

Table 10 – Cumulative Effects Assessment

Resource	Past Actions +	Present Actions +	Future Actions =	Cumulative Effects
Public Health & Safety	East Branch Dam was constructed to provide flood protection and low-flow augmentation. Impact – Positive	Interim operating pool will ensure public safety for residents downstream until dam repaired. Impact - Positive	The dam will be repaired to allow the pool to be operated normally. Impact - Positive	Public health & safety preserved. Cumulative Effect - Positive
East Branch Lake Water Quality and Fishery	AMD was not initially controlled, which caused severe water quality and aquatic habitat degradation. Impact – Negative	AMD treatment is ongoing and greatly improves water quality; it allows the lake to sustain a coldwater Lake Trout fishery, and a cool water fishery, including: smallmouth bass, muskie, and walleye. Modification of the control tower allows better control of water temperature releases during warmer weather, which will preserve the lake trout fishery during the time the interim pool is in effect. Impact - Positive	The dam will be repaired and the original water control plan will be re-instituted. AMD treatment measures will continue. Lake water quality will continue to improve and allow lake to become an even more productive fishery. Impact - Positive	Water quality and the lake fishery will continue to improve over time. Cumulative Effect - Positive
East Branch Clarion River & Clarion R., Downstream Water Quality and Fishery	AMD and industrial discharges severely degraded the water quality of the East Branch and Clarion Rivers Impact – Negative	The control tower modification allows better control of water temperature releases that will help maintain the cold water fishery downstream until the dam is repaired. Impact - Positive	AMD controls will continue to be implemented. The dam will be repaired and returned to normal operating conditions. NPDES permits will continue to protect the river. TMDL's will be established that will further protect downstream water quality. Impact - Positive	East Branch and Clarion Rivers' water quality will continue to improve and support high quality downstream fisheries. Cumulative Effect - Positive

NPDES Permit Holders Downstream	<p>Industrial and municipal discharges were not controlled when East Branch Lake was initially constructed.</p> <p>Impact on industry - None</p>	<p>State controls were implemented via NPDES permits. The permits control the amount of pollutants that can be discharged from industries and municipalities. The interim operating pool will not affect municipal sewage treatment or water treatment facilities, except under drought conditions.</p> <p>Impacts - None</p>	<p>The dam will be repaired and returned to normal operating conditions. NPDES permits will continue to require restrictions on industrial discharges. Industries and municipalities will continue working with state to meet future restrictions on discharges.</p> <p>Impact - None</p>	Cumulative Effect - None
Recreation Lake	<p>Recreation has been a popular activity, especially since the improvements in lake water quality.</p> <p>Impact – Positive</p>	<p>The interim pool will decrease lake recreation by reducing the amount of time that the two boat launching ramps can be accessed and used.</p> <p>Impact - Temporary Negative</p>	<p>The dam will be repaired and lake recreation will return to normal.</p> <p>Impact - Positive</p>	Cumulative Effect - Positive
Recreation Downstream	<p>After AMD treatment was implemented on East Branch Lake tributaries, a 5-mile section of the Clarion River was designated a Wild and Scenic River. The river corridor is a popular destination for fishing, small non-powered water craft, swimming, and other river-oriented recreation.</p> <p>Impact –Positive</p>	<p>The interim pool operations will not affect downstream recreation, except under drought conditions.</p> <p>Impact – None</p>	<p>After the dam is repaired, the lake will be operated normally.</p> <p>Impact -None</p>	Cumulative Effect - Positive
Wetlands	<p>AMD and industrial pollution may have affected wetland development, but the extent of the negative impact is unknown.</p> <p>Impact – Unknown</p>	<p>Temporary gain in wetland acreage with the lower interim pool.</p> <p>Impact – Temporary Positive</p>	<p>The pool will eventually be restored. Wetlands will re-establish as they existed prior to the emergency drawdown.</p> <p>Impact - None</p>	Cumulative Effect - None
Endangered Species	<p>AMD and industrial pollution eradicated any endangered species present in the Clarion River</p>	<p>Interim pool operations will not significantly affect state-listed aquatic species.</p> <p>Impact - None</p>	<p>Pool will be returned to normal operating conditions.</p> <p>Impact – None</p>	Cumulative Effect - None

	Impact – Negative			
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6.0 Status of Compliance with Environmental Protection Statutes

Table 11 lists the Federal Statutes with which the Corps of Engineers must comply.

Table 11 – Compliance with Federal Statutes

FEDERAL STATUTES	Interim Operating Pool 1650	Permanent Repair Alternatives
Archeological and Historic Preservation Act as amended, 16 U.S.C. 469, <u>et seq.</u>	FC	FC
Clean Air Act as amended, 42 U.S.C. 7401, <u>et seq.</u>	FC	FC
Clean Water Act (Federal Water Pollution Control Act) as amended, 336 U.S.C. 1251, <u>et seq.</u>	FC	FC
Endangered Species Act as amended, 16 U.S.C. 1531, <u>et seq.</u>	FC	FC
Federal Water Project Recreation Act as amended, 16 U.S.C. 406-1 (12), <u>et seq.</u>	FC	FC
Fish and Wildlife Coordination Act as amended, 16 U.S.C. 661, <u>et seq.</u>	FC	FC
Land and Water Conservation Fund Act as amended, 16 U.S.C. 4601-4601-11, <u>et seq.</u>	FC	FC
National Environmental Policy Act as amended, 42 U.S.C. 4321, <u>et seq.</u>	FC**	FC**
National Historic Preservation Act as amended, 16 U.S.C. 470a, <u>et seq.</u>	FC	FC
Rivers and Harbors Act, 33 U.S.C. 401, <u>et seq.</u>	FC	FC
Rivers and Harbors Act, 91 U.S.C. 122, <u>et seq.</u>	FC	FC
Watershed Protection and Flood Prevention Act, 16 U.S.C. 1001, <u>et seq.</u>	FC	FC
Wild and Scenic Rivers Act as amended, 16 U.S.C. 1271, <u>et seq.</u>	FC	FC
EXECUTIVE ORDERS, MEMORANDA, ETC.		
Floodplain Management (E.O. 11988)	FC	FC
Protection of Wetlands (E.O. 11990)	FC	FC
Protection of Children (E.O. 13045)	FC	FC
Environmental Justice in Minority Populations and Low-Income Populations (E.O.12898)	FC	FC
Analysis of Impacts on Prime and Unique Farmland	FC	FC
State And Local Policies	FC	FC

FC = full compliance; NA= not applicable

**Full compliance achieved after the District Engineer signs the FONSI –

7.0 Agencies, Organizations, and Persons to Whom Copies of Statement Sent

The mailing list used for this Dam Safety EA and draft FONSI is Appendix C.

8.0 Appendices



Appendix A – E. Branch Dam Interim EA and FONSI, June 2009

Appendix B – E. Branch Dam Interim Correspondance <responses due for Dam Safety>

Appendix C – Mailing List for Dam Safety EA and Draft FONSI <an Excel file>

9.0Draft Finding of No Significant Impact (FONSI).....

Draft Finding of No Significant Impact (Permanent Repairs) East Branch Dam Safety Modification East Branch Clarion River Elk County, Pennsylvania

In January 2008, the U.S. Bureau of Reclamation and the U.S. Army Corps of Engineers, Pittsburgh District (Corps) determined through a series of studies that East Branch Dam had potential structural deficiencies that could cause it to unexpectedly fail. Consequently, in February 2008, the Corps lowered the summer and winter operating pools of East Branch Clarion River Lake by 20 and 30 feet, respectively, as an interim emergency measure to reduce the potential risk of a catastrophic failure of the dam.

From that time, the District has also implemented a number of secondary interim risk reduction measures (IRRM). These measures include: an extensive communication plan to keep stakeholders and the public informed of activity at East Branch Dam; the enhancement of existing instrumentation and more frequent collection of critical instrument readings to better monitor the condition of the dam; cross-training of regional staff to support staff at the dam; the initiation of 24-hour staffing to monitor the condition of the dam; an updated Emergency Action Plan to re-evaluate emergency procedures; the development of new inundation mapping to better define the floodway downstream of East Branch Dam; more drills and exercises to better educate staff and local emergency management personnel; the pre-positioning of resources at the dam for emergency response; and the improvement of project lighting systems. These interim measures (i.e., the lowering of pools and secondary measures described above) were addressed *ex post facto* in National Environmental Policy Act (NEPA) documentation, coordinated extensively with the public, and concluded with a “Finding of No Significant Impact” (FONSI) on 15 June 2009.

Since February 2008, the District has formulated and evaluated a number of permanent repair alternatives. These repair measures and their potential socio-economic and environmental impacts are described in detail in a second Environmental Assessment (EA), with the purpose of implementing a repair alternative that permanently reduces the risk of dam failure to meet the Corps’ tolerable risk guidelines. The need for this action is to reduce the probability of failure of the dam and, in turn, to reduce the potential risk of life loss, and economic and environmental impacts downstream. The array of repair alternatives considered includes a “No Action” alternative, whereby the lower interim pools would be adopted permanently, along with all current IRRMs (discussed above). This alternative and the repair alternatives are listed below with brief descriptions:

Alternative <i>Plan NS1</i> ("No Action" alternative).	Non-structural: would make permanent the current lower interim pool levels (El.1650 summer, El.1623 winter), along with all current interim risk reduction measures.
Alternative <i>Plan S3</i> –PREFERRED PLAN–	Structural repair: an impervious full-depth cut-off wall drilled into bedrock, the full length of the dam at about center-line, with foundation grouting and secant shafts.
Alternative <i>Plan S4</i>	Structural repair: an embankment extension immediately downstream of existing dam, using the top portion of the dam for fill, and additional fill from a nearby hillside; coupled with a full-depth cut-off wall at the toe of the existing dam.
Alternative <i>Plan S5</i>	Structural repair: a concrete gravity structure, positioned near downstream toe of existing dam. Structure would include a drainage gallery and foundation grout curtain for seepage control.
Alternative <i>Plan S6</i>	Structural: removal of East Branch Dam, ensuring run-of-river conditions at all times. A significant portion of the embankment would be removed and stable slopes created on what remained of the embankment. Disturbed areas would be re-vegetated.

Plan NS1 would make permanent all IRRMs at East Branch Dam, including the lower pool elevations; however, the estimated annual loss of economic and recreational benefits would be \$1-8 million. Moreover, the dam's flood control capabilities would be reduced, and current IRRMs were not developed to be maintained safely indefinitely. *Plan S6* would remove East Branch Dam; however, this would result in the total loss of flood control (resulting in severe periodic flood risk) and operational capacity for low-flow augmentation (resulting in severe water quality and quantity issues downstream). Additionally, both the cold water lake fishery and downstream cold water fishery would be lost; and with the loss of the reservoir, increased levels of acid mine drainage and periodic heavy sediment washout from the exposed reservoir bottom would impact remaining aquatic life downstream—including two Pennsylvania state-listed species. *Plans S3, S4, S5* are similar in the benefits they would provide; however, *S4* and *S5* would both require new construction, extending about 600 feet past the current dam's toe, destroying that downstream section of the river. Additionally, both plans would cost considerably more than *Plan S3* and take considerably longer to build than *Plan S3*. Thus, *Plan S3* is the preferred plan.

After having carefully evaluated and balanced all beneficial and detrimental aspects of the alternative repair actions, including all regulatory agency input, it has been preliminarily determined that the recommended plan to install a full-depth cutoff wall, constructed with secant piles, along the entire length of East Branch Dam, along with foundation grouting (i.e., Alternative Plan S3), does not constitute a major Federal action significantly affecting the quality of the human environment. In accordance with 40 C.F.R. § 1508.13 (1), it has been determined that these actions will not cause any significant, long-term adverse effects to the aquatic habitat and wetlands within East Branch Clarion River Lake, the East Branch Clarion River, or the Clarion River; or cause impacts to ground-water resources, riparian habitat, wild and scenic rivers, geology, soils, socio-economic conditions, recreation, aesthetics, air quality, or ambient noise levels.

It is the District's opinion that East Branch Dam may be eligible for inclusion in the National Register of Historic Places; however, the proposed internal repairs to the dam described in the EA are of such a nature that they should not adversely affect any of the seven aspects of integrity important to Section 106 compliance. The District's preliminary determination is that for the dam repair alternatives, full compliance with Section 106 will be achieved without an issue of significant impacts to a historic property that would require further NEPA consideration.

Consequently, for the proposed dam repairs, the preparation of an environmental impact statement under NEPA is not warranted. Public interest will best be served by repairing the dam to make it safe for the foreseeable future. The proposed work is in compliance with all applicable Federal, State, and local laws and regulations. There are no unresolved issues regarding environmental compliance and coordination, and there are no unresolved environmental issues associated with the repairs needed for East Branch Dam.

The District's final determination will be made after consideration of all public input from the NEPA public review process. Letters have been mailed to over 200 recipients, directing them to the Corps' public website, and inviting their review and comment regarding the second "East Branch Dam–Dam Safety Modification EA and draft FONSI" that addresses the Corps' repair alternatives, including the preferred plan (Alternative Plan S3), which would permanently reduce the risk of dam failure at East Branch Dam. Execution of the FONSI will precede an agency final decision on the proposed action.